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Janusz Nesterak, Bernard Ziębicki

Editorial. Public Transformations: Infrastructure, Ecology, Law, and Management in Modern Society

In recent years, the development of infrastructure, ecology, legal regulations, and integrated safety management in public spaces has gained particular importance, as these domains have become essential not only for creating comfortable and secure public spaces, but also for shaping a more sustainable and socially-responsible urban environment. Changes in these areas – perceived as common and fundamental to global society – reflect a growing awareness of challenges in local communities, particularly those posed by ongoing urbanisation, climate change, and the need for efficient and inclusive public services.

In this issue of our journal, we present five exceptional analyses that explore various dimensions related to infrastructure, ecology, governance, and legal regulations within the public sphere. These articles address issues such as transport exclusion, the role of telemedicine in environmental protection, integrated safety management of large-scale cultural events, the interpretation of legal norms for municipal companies, and the impact of urban transport infrastructure on the users' sense of safety. Each of these topics contributes important insights and recommendations, which, while varied in focus, collectively create a cohesive picture of contemporary challenges and directions for development in public governance.

Transport exclusion is a phenomenon that particularly affects residents in areas distant from major centres, where transportation infrastructure is often inadequate (Hine, 2009), as the authors Katarzyna Szczecina and Monika Ziółko report. The case of the Nowosądecki district illustrates that the lack of convenient connections to places of employment, education, and health care adversely impacts individual development opportunities and – at the macro level – society as a whole. Transport exclusion, therefore, becomes a driver of social marginalisation, posing a significant issue for local governments and public organisations.

Research conducted in the Nowosądecki district reveals that limited access to public transport creates both economic and social barriers. Despite their desire to actively participate in socioeconomic life, residents face obstacles that contribute to their exclusion. Based on these findings, local leaders and decision-makers face a critical challenge, namely how to improve the accessibility of transport services to counteract exclusion and foster social inclusion. Maintaining an adequate public transportation system is one of the fundamental tasks of local administrative units and an example of how public infrastructure directly impacts the quality of life and economic development (Mackett & Thoreau, 2015).

The technological transformations currently unfolding extend into health care. **Telemedicine as a groundbreaking communication tool** offers opportunities to reduce CO_2 emissions by minimising the number of in-person medical visits and trips to health care facilities. The COVID-19 pandemic accelerated the implementation of tele-consultations and the widespread

use of the IoMT (Internet of Medical Things), providing evidence that innovations can effectively contribute to reducing the carbon footprint in health care (Schmitz-Grosz et al., 2023).

The article on telemedicine's impact on reducing carbon emissions is written by Krystian Bień and Mariusz Rafało. Potential benefits stemming from modern solutions that could lay the groundwork for a more ecologically-sound approach to public services are presented (Purohit, Smith, & Hibble 2021). As technological advancements continue and ecological awareness increases, society recognises that health and environmental protection can progress together. However, technology alone is not sufficient; an appropriate strategy for implementing these solutions is necessary, particularly in regions where access to modern communication tools remains limited.

Large-scale artistic and entertainment events are an integral part of social life, yet organising them requires meticulous planning and effective safety management for attendees. The article by Katarzyna Sułek concentrates on an analysis of a case study of an outdoor concert in Poland and addresses issues related to **implementing integrated safety management**. Achieving a high level of safety necessitates collaboration between event organisers, security services, and information providers, as well as establishing clear regulations.

The study emphasises that effective safety management requires proper coordination and flexibility in adapting to changing circumstances (Wiśniewski & Zwęgliński, 2022). Integrating activities across various services enables rapid response and risk minimisation in crisis situations. This aspect becomes increasingly important as the number of large-scale events grows, along with the scale of safety challenges. Properly planned and managed events, supported by modern technologies, not only are safe but also positively impact the perception of public space as a setting conducive to social bonding (Falkowski & Liberek, 2019).

The operation of municipal companies – especially those in which local governments hold the majority of shares – presents significant challenges for legal regulation (Peshin & Леонидович, 2019). The article addressing the interpretation challenges of legal norms for these entities reveals substantial gaps and inconsistencies in regulations that affect management efficiency and financial transparency (Harbich, 2014). In the absence of clear legal standards, local municipal companies often interpret laws based on "best practices," which leads to controversy.

In their article, the authors Edyta Bielińska-Dusza, Ewa Suchowińska, and Małgorzata Synowiec propose **the standardisation of legal definitions for municipal companies as well as the creation of cohesive regulations** that could enhance transparency and operational efficiency (Malarewicz-Jakubów & Brzozowski, 2023). In the context of public governance, clarity in legal norms is the foundation for responsible and ethical public fund management. Efficiently operating municipal companies contribute to a higher quality of life for residents, providing high-level public services and safeguarding the local environment (Gyurita, 2020).

Although primarily designed to facilitate mobility, transport infrastructure also has a significant impact on the residents' sense of safety (Askarnia & Ghaffari, 2022). The study on Kraków's transport infrastructure highlights that modern, well-planned transportation systems not only improve travel convenience, but also enhance user safety. From the perspective of city management, effective transport solutions, such as safe pedestrian crossings and bicycle paths, have a measurable impact on the residents' quality of life and the city's overall appeal. As reported by the author Jarosław Świda, the focus on infrastructure development entails investment not only in technology but also in raising awareness and fostering the users' sense of safety, which encourages inclusivity and mobility. In increasingly urbanised environments, cities face the task of balancing the needs of different user groups, including pedestrians, cyclists, and drivers. Thoughtful management

of transport infrastructure is a strategic element in creating a welcoming urban environment that promotes social integration and reduces greenhouse gas emissions (Tasic & Porter, 2016).

All five articles present different but **interrelated aspects of public governance**, highlighting the growing importance of integrated action, transparency, and sustainable development in the public sector. Issues such as transport exclusion, carbon footprint reduction, public space safety, municipal company efficiency, and transport infrastructure safety illustrate that contemporary public governance demands the holistic approach.

The conclusions drawn from these studies are clear: the key to the future of the public sector is a sustainable approach that combines technology, process management, and social inclusivity. Each of these areas contributes unique value to the broader picture of modern public governance, which should be based on the principle of **"pro bono publico" – for the public good**. How we address challenges within the public sphere forms the foundation upon which we build a future society that values both the natural environment and the quality of life for future generations.

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Katarzyna Szczecina, Monika Ziółko

The Impact of Transport Exclusion on the Socioeconomic Development of the Nowosądecki District

Abstract

Objective: The aim of the article is to present the phenomenon of transport exclusion related to limited access to means of public transport and its impact on the socioeconomic development of the Nowosądecki district. The article also presents aspects related to social exclusion caused by limited access to work, education, health care, and recreation resulting from the lack of sufficient means of transport.

Research Design & Methods: In order to achieve the assumed goal, the method of analysing the literature on the subject and empirical research in the quantitative approach (survey study) was used.

Findings: The analysis of the research results showed that more than half of the respondents have problems with the use of public transport in the Nowosądecki district, which makes them feel excluded in terms of communication. Moreover, the conducted research proves that the main problem affecting the resignation from using public transport is the lack of direct connections between the place of residence and work, school, or recreation used by the respondents. The conducted research also showed a correlation between the respondents' income and the frequency of using public transport; the higher the average monthly net income of the respondents, the less often they use public means of transport.

Implications/Recommendations: The results of the survey showed that the inhabitants of the Nowosądecki district feel excluded in terms of communication. The existing transport system requires significant improvements in the functioning of public transport.

Contribution/Value Added: The conducted research makes it possible to organise the knowledge on communication exclusion and its impact on the deepening of social exclusion. It also shows the motives of travellers when choosing a means of transport, thus indicating possible paths for further improvements in the transport system.

Article classification: research article

Keywords: transport, communication exclusion, social exclusion, public means of transport

JEL classification: R41, R42, R58

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Introduction

Both the desire to achieve a stable professional and financial position as well as the search for new places of employment or residence is associated with the necessity to move between different areas. Having a wide range of responsibilities and scarce time resources leads to a widening circle of society that moves by private means of transportation. The increase in the number of cars not only contributes to traffic congestion, but also makes many areas financially unfavourable for the operation of public transport. The situation that has arisen often forces carriers to withdraw from areas that over time become unprofitable. These phenomena affect the occurrence of disorders in the existing transport system, which consequently lead to the post-emergence of transportation exclusion in the region. People who live in these areas and do not have private means of transportation are deprived of the possibility to reach their workplaces, schools, doctors, and other centres of social life, which, as a consequence, may contribute to the phenomenon of the social exclusion of the residents of the regions in question (Ng et al., 2017). Unfavourable transportation conditions deepen social exclusion through barriers in employment, exclusion from various types of services, the feeling of safety, decreased level of education, and inequalities in the sphere of access to health services (Delbosc & Currie, 2011; Clifton & Lucas, 2004).

The research conducted systematises knowledge of the phenomenon of transportation exclusion and provides information on the perception of this issue by the residents of transportation-excluded areas. The results of the research make it possible to identify the dependencies that affect the aggravation of this phenomenon, but also make it possible to set a direction for the elimination of bottlenecks in this area. In the literature, there is still a lack of scientific items based on social research dealing with the topic of communication exclusion in the regions; this article partly tries to fill this research gap.

The purpose of the article is to present the phenomenon of transportation exclusion associated with limited access to public transportation and its impact on the socioeconomic development of the Nowosądecki district. The Nowosądecki district is located in the southern part of the Lesser Poland voivodeship (powiat.krakow.pl, 2015). It is an area inhabited by a growing population. In 2020, the county was inhabited by 214,502 people, while in 2022, it was already 214,933 people (GUS, 2023). In addition to the constant population growth in this area, it was selected for analysis due to the increasing economic development in these areas, the creation of new enterprises, which additionally favours internal migration of the population. Among other things, for these reasons, it is an interesting research area and can be a good basis for further research of this type in the area of transport exclusion at the regional level. To achieve the objectives, the method of analysis of the literature on the subject and empirical research in quantitative terms (questionnaire survey) was used. The following research questions were also formulated to help achieve the goal:

- What are the factors that guide the surveyed residents when choosing the way to get around in the Nowosądecki district?
- What are the most common reasons related to the abandonment of moving by public transport according to the respondents?
- Does the amount of income of the respondents affect decisions related to the choice of means of transport?
- Do the surveyed residents of the Nowosądecki district feel excluded by transportation?

The article consists of four parts. The first part presents a review of the available literature on the phenomenon of traffic exclusion at the level of regions in Poland. The second part presents

the research methodology, while the third one reveals the results of the conducted research. The article ends with research conclusions and recommendations.

Literature review

The literature contains studies on traffic exclusion in Poland. Some of the studies cover the whole country, with a particular focus on rural areas and small towns (Dubicki, 2019), including the research presented by Kaczorowski (2019b) showing the causes of traffic exclusion. The increased motorisation of society, which has consequently led to a decline in the viability of public mass transportation, was identified there as the main source of the problem. Problems related to the privatisation of state-owned enterprises and the lack of an adequate system to subsidise public transportation were also presented (Kaczorowski, 2019b). In another article, Kaczorowski also points to the 1990 political system reform as the main source of the decline of the State Automobile Transport Company (PKS), and the consequent deepening of the phenomenon of transportation exclusion. The research also points to the lack of adequate regulations to influence the operation of private carriers, which would expand the transportation offer in excluded regions (Kaczorowski, 2019a; Soboń, 2022). Another problem identified in the research is the underinvestment of some regions in transportation and expansion of the road network, mainly concerning peripheral areas, such as the Warmian-Masurian voivodeship, which, as the research has shown, is at the risk of transportation exclusion (Wolny et al., 2019).

The literature also frequently discusses the causes of transportation exclusion in selected regions, such as the Lower Silesian voivodeship, where rail stations have been eliminated, thereby creating sub-regional areas of transportation exclusion (Smolarski & Raczyk, 2017), as well as in some urban centres of, e.g., Central Pomerania, such as the areas of the Wałecki, Drawski, or Bytewski districts, which are deprived of the possibility of reaching district power centres (Parol, 2021). Similar situation is in the Komańcza area, where many bus lines were eliminated after a major transportation carrier had withdrawn from the area (Ciechański, 2020).

When analysing the transport accessibility of individual areas, it is important to look at the problem comprehensively and to take into account, among other things, technical factors (including facilities for the disabled), spatial factors (the distance between the stop and the place of residence), informational factors (the availability of timetables), legal factors (luggage transport options), economic factors (the cost of tickets), and temporal factors (the frequency of departures) (Gadziński & Beim, 2009).When analysing time factors, transport delays associated with increased road congestion during peak hours should also be taken into account (Gadziński & Beim, 2010).

Available studies can be divided into those that discuss the overall transportation network (Parol, 2021) as well as those that point to the performance of a selected mode of transportation, such as railroads (Smolarski & Raczyk, 2017; Majewski, 2019).

Over the past few years, there has been the developing trend of household car ownership throughout the country. According to statistics from the Central Register of Vehicles and Drivers (CEPiK), between 2015 and 2020, the number of registered passenger cars increased by 53,367, or more than 10,000 per year (CEPiK, 2015, 2020). The increasing number of owned personal vehicles is causing a wide range of Polish residents to abandon the use of public transportation in favour of private means of transport. This leads to a decrease in interest in public mass transportation, i.e. public, systematic transportation of people that takes place at a fixed time and along a fixed line or transportation network (Gazette, 2021). Both the motorisation of society and economic

destabilisation dating back to the 1990s have contributed significantly to the regression of public transportation (Jakubowski & Dulak, 2018). The then-dominant bus services carried out by the PKS began to lose popularity to private carriers, which effectively took over passengers on profitable routes, leaving the state-owned companies with unprofitable routes (Kaczorowski, 2019, p. 11). The lack of profitability and the significant motorisation of society led to a reduction in the routes served, thus deepening the unpopularity of public mass transport. Between 1993 and 2016, interest in regular out-of-town bus transport, which is one of the means of public transportation, declined by 75%, while the availability of the offer decreased by 50% (Jakubowski & Dulak, 2018). It can be concluded that the decrease in interest in public transport was the reason for the reduction in the number of courses and areas of its operation. It is worth noting that, despite the growing trend towards the motorisation of society, there is still a wide group of people for whom public mass transportation is the only means of transportation. Adapting the existing infrastructure to private transport as well as limiting the area of operation of public transport contributes to the phenomenon of transportation exclusion. Transport exclusion means depriving the residents of an area of the possibility of using means of locomotion to get from one place to another (Warren, 2007).

The literature distinguishes several types of transportation exclusion (Currie et al., 2006). For example, Komornicki (2019a) distinguishes its two dimensions: social, concerning a group of people who do not have access to transportation services, and spatial, referring to a specific area. Church, Frost, and Sulivan (2000), on the other hand, proposed a division into seven categories in terms of transport system characteristics related to transportation exclusion. They distinguished spatial exclusion, temporal exclusion, physical exclusion, object exclusion, geographic exclusion, economic exclusion, and fear-based exclusion (Church et al., 2000).

Limitations related to the availability of public transportation significantly affect the opportunities for personal development of people living in excluded areas, often forcing them to give up work, education, or certain forms of leisure activities. This phenomenon causes them to be excluded from participation in social life on many levels (Antrop, 2004; Błażewski, 2019).

The phenomenon of social exclusion manifests itself, among other things, in the inability to participate in common activities and relationships generally available to most citizens at many levels (economic, cultural, social, and political). This significantly affects not only the quality of life of individual citizens, but also the cohesion and equity of society as a whole (Lucas, 2012, p. 106; Koliński, 2021). When analysing the phenomenon of social exclusion, it should not be seen at one level with poverty. Social exclusion is a much broader concept and poverty is only one of its dimensions (Kenyon et al., 2002; Tselios & Rodríguez-Pose, 2022).

Social exclusion caused by the inaccessibility of transportation is defined in terms of individuals and households. It manifests itself in the inability to obtain the necessary connections to services or places of employment to function properly in society (Kiciński et al., 2022). The transportation handicap of rural and peri-urban residents is caused by the lack of their own means of transportation and the low accessibility of public transportation, which can also be influenced by high ticket prices, as well as the lack of sufficient information about departures (Lucas, 2012). When analysing the issue of accessibility of public transport timetables, with particular reference to passenger rail, it should be taken into account that, in accordance with Article 30e of the Railway Transport Act of 28th March, 2003 (Dz.U. 2003 No. 86 item 789), the manager of the route infrastructure is obliged to inform potential travellers about departures using websites (Beim et al., 2019).

Transportation handicaps, together with social handicaps (caused by poor housing, low skills and income, and the lack of health or work), contribute to limited mobility, resulting in a lack of access to goods, services, life opportunities, social capital, and many other constrictions, thus creating the phenomenon of social exclusion (Figure 1) (Lucas, 2012). Many studies emphasise the fact that socially-excluded people often do not find themselves in this situation by their own choice, but because of certain factors in their environment (Church et al., 2000). Moreover, despite their high level of willingness, they are not able to cope with the problem on their own (Zmuda-Trzebiatowski, 2016).

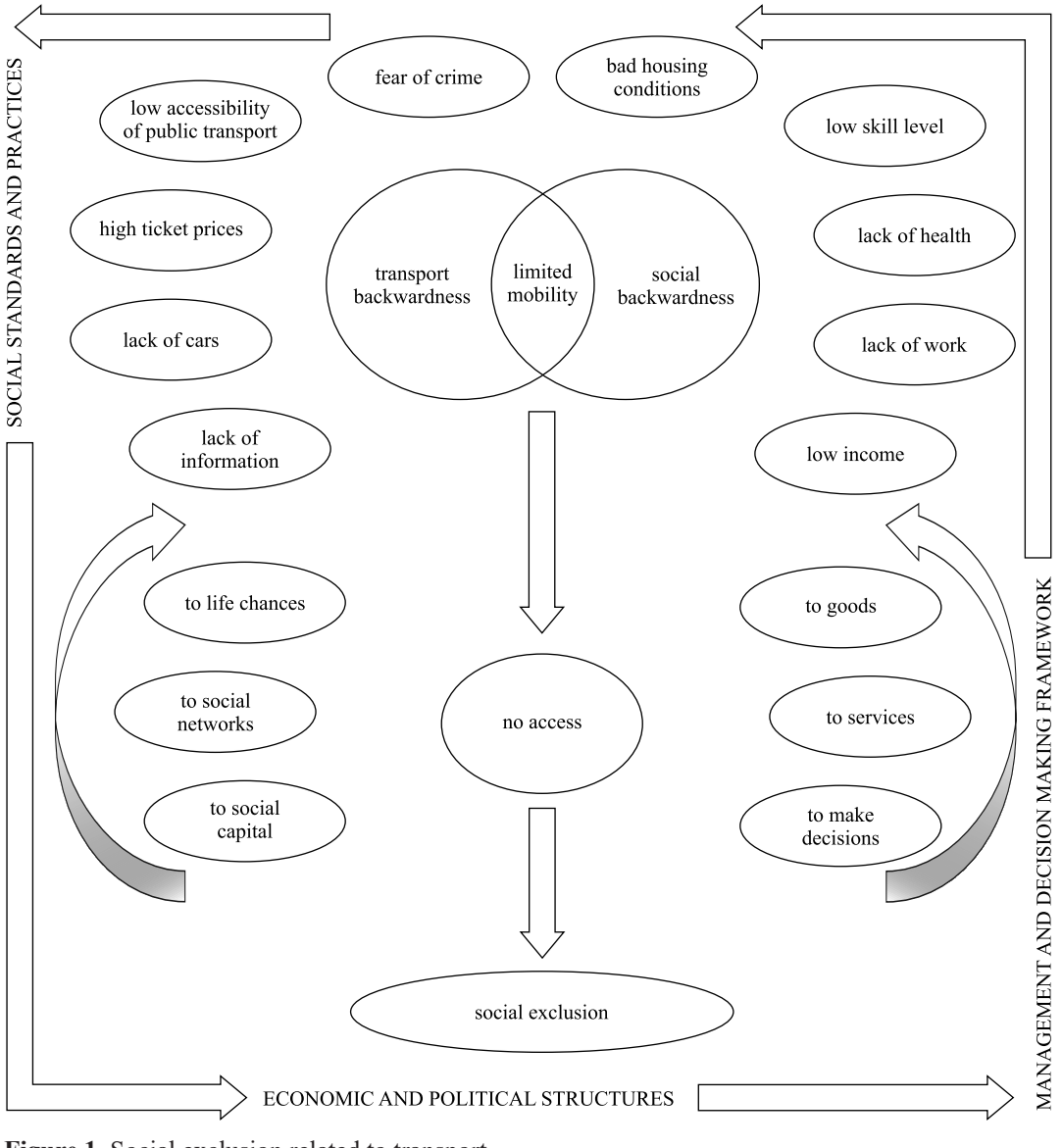

Figure 1. Social exclusion related to transport

Source: Own compilation based on conducted surveys.

The complete lack of availability of public transportation, or its inadequacy to meet the needs of travellers, has a negative impact on both the residents of rural and suburban areas, as well as on the cities themselves. An analysis of a report prepared by the Polish Academy of Sciences indicates the widespread nature of the problem in Poland, as more than 20% of villages do not have access to any means of public mass transit, and in many places, of the remainder, there are only two buses a day (Kaczorowski, 2019b, p. 12). During a survey of rural areas, it was discovered that by eliminating public transport connections, as many as 28% of the respondents had problems getting to work, thus forcing them to buy a car or give up their previous employment, thus losing their source of income (Taylor, 2007). Researchers point to the significant impact of the lack of the availability of adequate transportation on the problems of permanent unemployment, as it is often the case that for people living in rural areas, it does not pay to take jobs in remote, inaccessible places. Moreover, the presence of a transportation barrier limits the possibility of improving conditions in local labour markets, as employees, fearing the loss of their positions and the inability to obtain new employment, are forced to perform work under unfavourable contracts (Berezowski, 2017, p. 23). The problem of the lack of adequate transportation is also evident in the case of commuting to school. As many as 41% of students living in rural areas reach educational institutions via school bus, while 17% travel by a PKS bus. Despite the prevalence of using buses to reach educational sites, more than half of the trips (51%) were considered impractical. The lack of adequate transportation to get to school efficiently causes a significant proportion of students to choose inferior facilities with more favourable travel options over better ones with more complicated commuting options (Taylor, 2007, p. 177). Admittedly, the Act of 14th December, 2016, on Education Law imposes an obligation on municipalities to transport pupils to school if the distance from the school facility to home, as indicated in the Act, is exceeded. However, this only applies to pupils in grades I-VIII of primary schools and disabled persons up to the age of 21. As a result, young people are often forced to give up their plans and dreams of continuing their education in certain high schools (Łyszczarz, 2021). Moreover, the elimination of connections provided by public mass transportation has a negative impact on the health and lives of people living in rural and suburban areas, where access to health services is significantly limited. The reduction in the number of connections between the place of residence of the rural population and the areas where health centres, pharmacies, and specialty clinics are located means that those who require a medical visit rely solely on the assistance of motorists, which largely contributes to the development of serious diseases, as well as an increase in mortality among the rural population. The lack of mobility significantly affects not only sick people, but also the prevention of healthy people, who have limited access to many examinations due to the lack of transportation. Therefore, local governments, when analysing the transportation needs of residents, should give special consideration to the possibilities associated with reaching doctors and diagnostic points. The inaccessibility of public transportation is particularly felt by the elderly, who typically face health problems and are more likely to show the need for a medical visit. Due to their level of dexterity, these people rarely own their own vehicles, which not only affects the quality of their physical health, but also their mental health. The lack of transportation limits the ability to visit friends and family, thus causing isolation for the elderly and a deterioration in their standard of living. Transportation problems occurring in small towns have a significant impact on the formation of social distances and the development of differentiation among the population (Dybalski, 2018). Despite efforts to develop both rural and urban areas, the elderly and people with disabilities still have to face a number of problems caused by inadequate land use and the failure to adapt

infrastructure and public transportation to their needs. These barriers result in the exclusion of certain social groups, limiting their ability to use goods and services available to the public, both when moving by their own and public transportation, as well as when travelling on foot. In addition, the problem of transport exclusion was exacerbated during the COVID-19 pandemic in terms of reduced bus and rail routes and frequencies (Orchowska, 2022).

Despite readily apparent deficiencies in the adaptation of infrastructure elements, vehicles, and schedules to the needs of travellers, social exclusion caused by transportation problems often remains misunderstood and inadequately defined, which may be due to inadequate testing of measurable indicators. As a result, both theoretical and operational measures of transportation inconvenience are not evaluated when analysing social exclusion. Often, surveys are conducted for the purpose of immediate improvement, without adequate preparation, with the result that social groups that are actually disadvantaged are not properly identified. As a result, despite taking measures to improve the existing transportation system and reduce social exclusion, the problems of individuals may still remain unresolved (Kamruzzaman et al., 2016, p. 2). Therefore, it is important to first properly identify units and areas facing transportation problems, and then take adequate measures to improve the existing system.

Research methodology

The purpose of the research was to assess and analyse the state of existing public transportation, elements of transport infrastructure, and the occurrence of the phenomenon of traffic exclusion in the Nowosądecki district. For the implementation of the study, the following research problems were identified:

- What are the factors that guide the surveyed residents when choosing the way to get around in the Nowosądecki district?
- What are the most common reasons related to the abandonment of moving by public transport according to the respondents?
- Does the amount of the income of the respondents affect decisions related to the choice of means of transport?
- Do the surveyed residents of the Nowosądecki district feel excluded by transportation?

The theoretical part of the study is based on a review of the literature on the occurrence of the phenomenon of communication exclusion and the consequences it entails. The empirical part, on the other hand, consists of an analysis of the results of our own research, conducted on a group of 141 respondents, using a survey method (questionnaire survey).

The survey of public opinion was conducted on the basis of a survey questionnaire tool. The questionnaire was aimed at the residents of Nowy Sącz and the Nowosądecki district, as well as people who do not live in but travel in the mentioned areas. The questionnaire was prepared in the electronic form and distributed using social media between mid-March and early May 2022. The form consisted of one verification question, five metric questions (Table 1), and twelve survey questions, three of which were open-ended questions and nine of which were closed questions.

Three of the closed-ended questions were single-choice and six consisted of determining with a scale the incidence of a particular factor or element. In addition to the verification question, the survey also included three filter questions designed to move the respondent to the appropriate section, depending on the given answer. A total of 147 people took part in the survey, of which six responses were rejected because the individuals do not live and have never travelled

within the Nowosądecki district. The selected group is not representative, although it allows the identification of transportation problems occurring in the Nowosądecki district.

Table 1. The characteristics of the respondents of the conducted research sample on the occurrence of the phenomenon of traffic exclusion in the Nowosądecki district

N = 141		Number of responses Percentage share	Number of responses Percentage share
Gender	Female	105	74
	Male	36	26
Age	Under 18 years	4	3
	18-25 years	38	27
	26-35 years	47	33
	36-50 years	44	31
	Over 50 years	8	6
Education	Elementary	5	3.5
	Basic vocational	5	3.5
	Secondary	56	40
	Higher	75	53
Employment situation	Student	20	14
	Unemployed	6	4.5
	Working	113	80
	Retired	2	1.5
Average monthly net income Gender	Less than PLN 1,000	17	12
	PLN 1,001–3,000	53	37.5
	PLN 3,001–5,000	46	32.5
	PLN 5,001–7,000	14	10
	PLN 7,001–10,000	4	3
	Over 10,000 PLN	7	5

Source: Own compilation based on conducted surveys.

Findings

The first research problem concerned the rationale behind the choice of mode of travel in the Nowosądecki district. In order to find an answer to the posed question, the respondents were asked to rate on a scale from 1 (never) to 5 (always) factors that guide them when choosing a means of transportation. The respondents evaluated 6 criteria such as price, the availability of means of transportation, convenience, speed/speed, direct connections, and safety. Of all the respondents, the broadest group – 84 people (59.5%) – indicated that they always follow direct connections when choosing a means of transportation, and only 12 people (8.5%) never follow this criterion. The calculations clearly indicate that direct connections are the main criterion when choosing a means of transportation, while price plays the least important role. Detailed information showing the determinants of travellers' choice of mode of transportation is presented in Table 2.

Table 2. The determinants of the choice of a means of transport

Rating scale from 1 (never) to 5 always)	Please indicate on a scale of 1 (never) to 5 (always) what guides your choice of a means of transportation											
	Price		Availability of a means of transportation		Convenience		Speed		Direct connections		Safety	
	N	%	N	%	N	%	N	%	N	%	N	%
	42	30	17	12	21	15	24	17	12	8,5	19	13
1	27	19	9	6.5	23	16	13	9	8	6	11	8
2	19	13	17	12	31	22	32	23	23	16	38	27
3	22	16	16	11.5	12	9	15	11	14	10	24	17
4	31	22	82	58	54	38	57	40	84	59,5	49	35
5	141	100	141	100	141	100	141	100	141	100	141	100
Total	2.81		3.97		3.39		3.48		4.06		3.52	

Source: Own compilation based on conducted surveys.

Another research problem concerned the reasons associated with the abandonment of the respondents from moving by public transportation. Analysing the above problem, the respondents were first asked to indicate the means of transportation by which they most often get around in the Nowosądecki district.

Table 3. The frequency of the use of various means of transport by travellers in the Nowosądecki district

Rating scale from 1 (never) to 5 (always)	How often do you move by particular means of transportation in the area of the Nowosądecki district?									
	Vehicle		Bike, scooter, skateboard, etc.		MPK bus		Private bus		Train	
	N	%	N	%	N	%	N	%	N	%
1	6	4.5	67	48	59	42	75	53	94	67
2	12	8.5	21	15	26	18	32	23	24	17
3	15	10.5	33	23	20	14	21	15	13	9
4	31	22	17	12	18	13	3	2	4	3
5	77	54.5	3	2	18	13	10	7	6	4
Total	141	100	141	100	141	100	141	100	141	100
Average	4.14		2.06		2.36		1.87		1.61	

Source: Own compilation based on conducted surveys.

In order to accurately illustrate the obtained data, during the analysis of the results, the arithmetic average of the evaluated elements was calculated. The calculations show that the vehicle that is most often used by travellers is the car. Detailed information is presented in Table 3.

Looking for reasons for giving up moving by public transportation, only the responses of people who chose their own means of transportation as their main means of transportation

in the Nowosądecki district were analysed. There were a total of 105 respondents, of whom as many as 60% (63 people) are always guided by the availability of direct connections, and only 10 (10%) respondents never pay attention to this criterion. The least important for travellers is the price; only 15 (14%) of the respondents in the group indicated that they are always suggested by the price, and for as many as 32 (30.5%) respondents the price is not a determinant affecting the choice of means of transportation (Table 4).

Table 4. The determinants of the choice of a means of transportation by those most likely to move via their own means of transportation

Rating scale from 1 (never) to 5 (always)	Please indicate on a scale of 1 (never) to 5 (always) what guides your choice of means of transportation											
	Price		Availability of a means of transportation		Convenience		Speed		Direct connections		Safety	
	N	%	N	%	N	%	N	%	N	%	N	%
1	32	30.5	16	15	16	15	16	15	10	10	17	16
2	25	24	7	7	16	15	8	7.5	5	5	8	8
3	14	13.5	13	12.5	25	24	23	22	16	15	28	27
4	15	14	12	11.5	7	7	9	8.5	11	10	15	14
5	19	18	57	54	41	39	49	47	63	60	37	35
Total	105	100	105	100	105	100	105	100	105	100	105	100
Average	2.66		3.83		3.39		3.64		4.07		3.45	

Source: Own compilation based on conducted surveys.

Next, the influence of the amount of monthly income on decisions related to the choice of means of transportation was analysed. Aiming to solve the indicated problem, a summary showing the relationship between income and the most frequently chosen means of transportation was prepared in Table 5. In order to better observe the results, a column was prepared indicating what percentage of people in each income group choose the appropriate means of transportation. Among those earning less than 1,000 PLN net per month, 5 (3.5%) of the respondents choose their own means of transportation, which is 29% of the respondents in the group of people earning less than 1,000 PLN, and as many as 12 (8.5%) people use public transportation – this is as much as 71% of those earning less than 1,000 PLN net per month. All the respondents earning between 7,000–10,000 PLN net per month (4 people – 3%) and those earning more than 10,000 PLN net per month (7 people – 5%) indicated that they most often get around in the Nowosądecki district by their own means of transportation. The analysis of the results clearly indicates that as monthly income increases, the number of people using public means of transport decreases. In order to confirm the validity of the conclusions drawn, a statistical Chi-square ($\chi 2$) test of concordance was conducted, which clearly indicates that the presented correlation is statistically significant, and thus the income of travellers has a significant impact on the means of transportation they choose.

The last analysed problem was the assessment of the surveyed residents of the Nowosądecki district regarding the occurrence of traffic exclusion in the district. Aiming to obtain an answer to the problem, the respondents were first asked to assess the number of transport infrastructure

elements present in the studied area. The availability of sidewalks, bicycle paths, paved roads, bus stops, information boards at bus stops, and timetables was assessed.

Table 5. The relationship between average monthly net income of the respondents and the most frequently chosen means of transportation in the Nowosądecki district

Average monthly net income	Please specify what means of transportation you use most often in the Nowosądecki district					
	Own means of transportation			Public transportation		
	N	% of total	% of row	N	% of total	% of row
Less than PLN 1,000	5	3.5	29	12	8.5	71
PLN 1,001–3,000	36	25.5	68	17	12	32
PLN 3,001–5,000	40	28.5	87	6	4	13
PLN 5,001–7,000	13	9	93	1	1	7
PLN 7,001–10,000	4	3	100	0	0	0
Over 10,000 PLN	7	5	100	0	0	0
Total	105	74.5	x	36	25.5	x
$\chi^2 = 29{,}3795$; $p = 0{,}00002$						

Source: Own compilation based on conducted surveys.

Table 6. The availability of individual elements of transport infrastructure in the Nowosądecki district

Scale	Please rate the availability of selected elements of transport infrastructure in the Nowosądecki district											
	Sidewalks		Bike paths		Paved roads		Bus stops		Information boards at bus stops		Timetables	
	N	%	N	%	N	%	N	%	N	%	N	%
Very small	9	6.5	22	15.5	8	6	9	6.5	20	14	19	13
Small	43	30.5	63	44.5	28	20	33	23.5	39	28	35	25
Sufficient	58	41	40	28.5	71	50	76	54	55	39	59	42
Large	22	15.5	11	8	28	20	17	12	20	14	20	14
Very large	9	6.5	5	3.5	6	4	6	4	7	5	8	6
Total	141	100	141	100	141	100	141	100	141	100	141	100

Source: Own compilation based on conducted surveys.

Most of the respondents – 22 people (15.5%) – indicated that there are very few bicycle paths in the study area, and 63 respondents (44.5%) believe there are few. Only 5 people (3.5%) think there are very many bicycle paths in the Nowosądecki district. More than half of the respondents – 76 people (54%) – indicated that the number of bus stops is sufficient, and 71 respondents (50%) say that the number of paved roads is also sufficient. A detailed summary of the assessment of the availability of various elements of transportation infrastructure is presented in Table 6.

The respondents were also asked to indicate whether there is traffic exclusion on the territory of the Nowosądecki county. 74 (52%) of the respondents believe that there is traffic exclusion on the territory of the Nowosądecki district, while 67 people (48%) deny the existence of this phenomenon in the studied area. Despite the fact that the differences in the statements are small, based on the opinion of travellers, it can be concluded that the Nowosądecki district is in many respects transport-excluded.

The survey clearly shows that even small improvements in the operation of public transportation, such as changes in departure times, can contribute to its attractiveness. It is important to regularly study the needs of travellers and constantly strive to meet them, as often small changes requiring low financial outlays can significantly affect the development of the transportation system, thus reducing the occurrence of transportation exclusion in the study area.

Conclusions

Despite the development of modern technologies, including in the field of urban transportation, in many areas it is still possible to observe problems related to the organisation of public transport. These difficulties lead to the occurrence of the phenomenon of traffic exclusion, which can consequently lead to social exclusion, which includes individuals deprived of the opportunity to get to work, school, doctor, or cultural and sports facilities.

Aiming to improve the transportation system, including the operation of public transportation, it is necessary to cooperate with both local governments and private carriers providing regular bus services. It is necessary to constantly survey public opinion on the functioning of public transportation, enabling the identification of problems associated with the use of carriers. Sampling for future surveys conducted in this area is also important. It would be worthwhile to reach out to more male respondents to also find out their opinion on transportation exclusion, and to find out the opinion of more diverse age groups, which would also benefit the survey results.

The research presented in the article made it possible to analyse the residents' assessment of the functioning of the transport infrastructure and public transportation occurring in the Nowosądecki district. Based on the results of the study, it can be concluded that the Nowosądecki district is a transport-excluded area. According to the opinion of travellers, this situation is significantly influenced by the lack of direct connections between the place of residence and work, school, and recreation centres, as well as the inadequacy of bus departure times to meet the needs of travellers.

Looking for opportunities to improve the functioning of public mass transit in the Nowsądecki district, many enhancements can be implemented, including not only changes in the bus timetable, but also expanding the areas where buses operate, or building transfer stations with a Park&Ride parking. Moreover, it is worth noting the potential of the region's railroads. The launch of local train lines would not only increase the comfort and satisfaction of travellers, but also reduce the level of pollution in the region through lower carbon dioxide emissions. It would be worthwhile to devote a little more space to this issue in future studies as well. The extension of the railroad in these areas could significantly improve the mobility of the population and reduce the phenomenon of transportation exclusion in these areas. The presented research has shown that traffic exclusion is a serious problem that often affects rural and suburban areas. The underestimation of its occurrence can prove disastrous in its consequences, bringing with it social exclusion with a negative impact on the level of the socioeconomic development of the excluded regions. The content presented in the article indicates the need for regular surveys of public opinion on satisfaction with

the functioning of public transportation and the desire to systematically introduce improvements in this area. The analysis carried out so far not only included a limited research sample, but was also significantly limited in time. When undertaking future research, it would be worth increasing the research sample, taking into account different age groups, genders, places of residence, social status, or education. An important factor that should be taken into account is the aforementioned expansion of the railway line in this area, repeating the study after the implementation of this plan and expanding its scope by the importance of the railway in the daily mobility of residents. It will make it possible to draw interesting conclusions and will be a stimulus for further research and analysis. Similar studies should also be conducted over a longer period of time due to disruptions that may be caused by factors such as season, weather, holiday period. A longer time perspective will also make it possible to see the impact of these factors on the perception of exclusion among the surveyed residents.

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The Impact of Telemedicine on Reducing Carbon Footprint

Abstract

Objectives: The purpose of this paper is to explore the possibilities of reducing the carbon footprint in the Polish health care, focusing on the way by which medical service professionals use communication technology to provide information for diagnosis, treatment, prevention, and consultation, or to obtain medical knowledge for the improvement of the patient's health.

Research Design & Methods: Based on data on the number of home visits and its connection with the number of teleconsultations in the surveyed region, the possibility of reducing the carbon footprint in this area was analysed. In addition, the population living in each region of the country was considered. Values were calculated for the years 2020 and 2021.

Findings: The correlation between the topic of decarbonisation and telemedicine (i.e. a form of medical and health care delivery that combines elements of telecommunications, information technology, and medicine). is quite obvious. A rather clear scenario confirming the positive impact of telemedicine on the environment is the minimisation of the need to visit medical centres by patients to obtain basic medical services (consultation with a clinician, prescription, etc.)

Implications / Recommendations: The possibilities that telemedicine brings to the health care field are immense, and the only limitation we currently face is the speed at which this technology is adopted in everyday realities. We are currently facing a paradigm shift in the perception of medical services from the traditional approach (one in which the patient had to reach a clinician in person to receive medical services) to the innovative one (supported by various technologies that make it possible to provide medical services remotely), which improves the quality of health care services. The COVID-19 pandemic has proven that some services can be delivered differently. The use of innovative methods of diagnostics and patient care using IoMT-related solutions contributes to reducing the environmental impact of the carbon footprint that is generated by the health care field.

Contribution / Value Added: Climate change has a significant impact on human health. Obviously, climate change is not the only factor affecting human health. In the article, we deliberately narrow the domain of analysis to this factor and will not consider a broader scope. In order to demonstrate the commitment to reducing their environmental impact, organisations and companies more often measure and report carbon footprint. Moreover, the pandemic crisis situation, i.e. COVID-19, has brought rapid changes in clinical practice. The huge potential of using the available technology – e.g. the IoMT (Internet of Medical Things) – to support the health care field has been recognised. This technology is one of the important elements of telemedicine.

Keywords: decarbonisation, telemedicine, carbon footprint in health care

Article classification: research article

JEL classification: Q560, I180, O330

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Introduction

Health care in Poland is publicly financed and provides access to medical services for the country's entire population. The health care system in Poland is based on health insurance, and funding is provided through the National Health Service (NHS) (NFZ, 2023). The health care system in Poland consists of two sectors – public and private. The public sector consists of public hospitals, clinics, and outpatient clinics, which are financed by the state and the insured. The private sector includes private clinics and hospitals, which can be accessed directly or through private insurance. There are many types of specialised medical services, such as treatment, diagnosis, rehabilitation, long-term care, and palliative care. Health care in Poland is also based on the primary care system, which provides access to primary care through family doctors and community nurses. However, Poland's health care system faces many challenges, such as the shortage of medical staff, inequality in access to medical services in rural areas, and low salaries for medical staff. As a result, the government is taking steps to modernise and improve Poland's health care system. Health care management optimisation is the process of improving operations to enhance the efficiency and quality of medical care while increasing savings. Here are some ways to optimise health care management (Wickramasinghe, 2020):

- the application of information technology – information technology, such as medical data management information systems, can help improve the efficiency and accuracy of medical data management as well as facilitate the management of financial and administrative data;
- efficient resource management – optimal management of resources, such as people, medical equipment, drugs, materials and services, can help minimise costs while increasing the quality of medical services;
- improving medical processes – understanding medical processes and using best practices can help reduce medical errors and improve patient outcomes;
- implementing standards and guidelines – implementing standards and guidelines for medical practices can help increase the quality of medical care, minimise the risk of errors, and increase patient safety;
- cooperation and coordination across sectors – collaboration and coordination between sectors, such as health care, long-term care, and social care, can help ensure consistent care for patients and minimise costs;
- continuous improvement – continuous improvement of medical processes and practices is key to ensuring continuous improvement in the efficiency and quality of health care.

Optimising healthcare management is a multi-step process that requires the involvement of both government authorities and health care professionals. An effective use of information technology, the improvement of medical processes, and continuous improvement are key to providing effective medical care while minimising costs and increasing quality.

The term 'Internet of Things' (IoT) was first used by British entrepreneur and startup founder Kevin Ashton (ETHW, 2023) in 1999, during a presentation to Procter & Gamble. IoT is a technology that allows various electronic devices to be connected to each other via the Internet, enabling real-time data transmission and collection.

The 'Internet of Medical Things' (IoMT) in healthcare is a way to describe the interconnected infrastructure of medical devices that doctors, patients, and consumers rely on (Kim et al., 2022). Surgical robots and smart monitoring equipment in hospitals are certainly prime examples of IoMT, but so are everyday fitness trackers, smart home monitoring devices, etc. In medicine, the IoMT has

many applications that contribute to improving the quality of health care and resource efficiency. The IoMT connects people (patients, caregivers, and clinicians), data (patient data or performance data), processes (care delivery and patient support), and tools (connected medical devices and mobile apps) to deliver better patient outcomes (Deloitte Centre for Health Solutions, 2018).

The primary difference between the IoT and the IoMT is the reliability of the devices as well as the issue of data security.

One of the most important applications of the IoMT in medicine is monitoring patients' health remotely. This allows doctors to track a patient's vital signs, such as blood pressure, heart rate, blood sugar, body temperature, and more, even when the patient is at home. In this way, health problems can be detected earlier and interventions can be made faster, resulting in improved treatment outcomes. The IoMT can also help optimise resource management in medical facilities. By using smart systems to monitor and control the consumption of resources such as water, energy, medical equipment, as well as disinfectants and other materials, costs can be saved while increasing the safety of patients and medical staff. Another application of the IoT in medicine is telemedicine, or the provision of healthcare services via the Internet. This allows patients to have faster and easier access to health care, while doctors can consult with other specialists, issue e-prescriptions, and conduct medical appointments online. Ultimately, the IoMT can help improve patient safety and the quality of medical care. Through the use of intelligent monitoring and alerting systems, potential health risks to patients, such as inappropriate medication dosages or the risk of hospital-acquired infections, can be detected more quickly. The use of the IoT in medicine has many benefits, such as increasing resource efficiency, improving the quality of health care, and enhancing patient safety.

Carbon footprint

What is a carbon footprint?

A carbon footprint (El Geneidy et al., 2021) is a measure of the amount of greenhouse gases, mainly carbon dioxide (CO_2), emitted into the atmosphere by a specific product, service, or process. It is a proxy for the environmental impact of a particular product, service, or process, particularly on climate change. The carbon footprint takes into account the greenhouse gas emissions over the entire life cycle of a product or service, from raw material extraction and production, to transportation, use, and disposal or recycling. This means that not only direct emissions related to production, but also indirect emissions related to electricity consumption, transportation or waste management are taken into account in calculating the carbon footprint. Determining the carbon footprint is important from the point of view of environmental protection and the fight against climate change, as it allows the identification of the largest sources of greenhouse gas emissions and the identification of measures to reduce them. The health care carbon footprint refers to the amount of greenhouse gases emitted by medical sector activities, including hospitals, clinics, laboratories, as well as by the production and distribution of medicines and medical equipment. According to a report by the Global Climate and Health Alliance, the health care sector is responsible for about 4.4% of global greenhouse gas emissions (Health Care Without Harm & Arup, 2019). The largest sources of emissions in health care include electricity, which is used heavily in hospitals and clinics, water consumption, medical transportation, and the use of medical equipment such as X-ray machines and CT scanners. However, many hospitals and clinics around the world are

taking steps to reduce their carbon footprint by investing in green technologies and renewable energy, reducing energy and water consumption, using greener modes of transportation, as well as reducing medical waste (García-Sanz-Calcedo, 2014). Reducing health care's carbon footprint will not only help protect the environment and combat climate change, but will also save money by reducing costs related to electricity, water, and waste disposal. At this point, it is worth mentioning that despite the fact that telemedicine does not play a key role in reducing the carbon footprint in the area of health care at the moment, there are several indications that this role may change dramatically in the future, taking into account several important arguments:

- Incremental Impact – while it is true that electricity, water, and medical equipment consume significant amounts of energy, telemedicine could still have an additive, positive impact on reducing a health care system's carbon footprint. Small increments, when amplified over large systems and periods, can produce meaningful changes.
- Indirect Reductions – telemedicine can lead to reduced patient and provider commuting, which, in turn, cuts down on emissions from transportation. When considered at scale, this could have a non-trivial effect. Moreover, if telemedicine can effectively deal with simpler cases online, it might lead to less frequent use of energy-intensive medical equipment and in-person resources for those cases, thereby indirectly contributing to decarbonisation.
- Future Scalability – as telemedicine technology improves, we may find ways to make it even more energy-efficient. Additionally, if telemedicine can take on a more significant role in health care delivery, including more complicated consults or even remote surgeries via robotics, the energy savings could be more substantial.
- Synergy with Renewable Energy – as health care systems increasingly adopt renewable energy sources, the carbon footprint of the electricity used for telemedicine could decrease, thereby enhancing its role in decarbonisation.
- Holistic View of Healthcare Emissions – decarbonisation is a complex problem requiring multi-faceted solutions. While focusing on the largest emission sources is crucial, a comprehensive strategy would also consider smaller contributors that could add up to a significant impact.
- Changing Landscape – the health care landscape is continually evolving, especially in the context of public health crises such as pandemics, where telemedicine has demonstrated its value. In such scenarios, the role of telemedicine and its potential impact on decarbonisation could be far more significant than in 'business-as-usual' conditions.

For these reasons, although telemedicine's contribution to reducing carbon footprint might not be 'statistically significant' at the moment when compared to the major sources of health care emissions, its potential cumulative benefits should not be underestimated. The paper aims to shed light on these benefits, thus contributing to the wider discourse on health care decarbonisation.

What is telemedicine?

According to the definition of the American Telemedicine Association (ATA), telemedicine is a form of medical information exchange at a distance through electronic communication to improve a patient's health (Miller, 2020). In contrast, the World Health Organization (WHO) states that telemedicine is the provision of medical services by professionals, where distance is a major factor, using communication technologies to exchange relevant information for diagnosis, treatment, prevention, consultation, or obtaining medical knowledge for the improvement of the patient's health (WHO Group Consultation on Health Telematics, 1998). Telemedicine (Szpor et al.,

2019) is a medical field that uses information and communication technologies (ICTs) to provide remote medical services. It involves the use of advanced communication technologies such as teleconferencing, mobile applications, online consultations, and health monitoring systems to allow patients to remotely access medical services and medical consultations as well as diagnose diseases, prescriptions, etc. Telemedicine can be used to provide remote medical assistance to patients who live in remote regions where access to traditional medical care is limited or difficult. Patients can access medical services without leaving home, which is especially important for the elderly, the disabled, and those with limited mobility. Telemedicine can also help reduce waiting times for medical appointments and increase the efficiency of the treatment process through faster diagnosis and treatment. In addition, by remotely monitoring patients, such as using devices to measure blood pressure or blood sugar levels, it is possible to detect health problems more quickly and intervene faster if a patient's condition worsens. Telemedicine is increasingly used in various medical fields, such as cardiology, dermatology, psychiatry, neurology, rehabilitation, geriatrics, and many others. In Poland, telemedicine is increasingly used in various fields of medicine, both in the public and private sectors (Król-Całkowska, 2021). Here are examples of the use of telemedicine in Poland (Centrum e-Zdrowia, 2022):

- Under a pilot programme of the National Health Service (NHS), telemedicine is being used for specialised consultations. Patients have access to doctors of various specialties, such as a cardiologist, a dermatologist, a pulmonologist, a neurologist, a psychiatrist, or a endocrinologist, who provide advice and consultation via the Internet.
- Telemedicine is also used in health programmes, such as preventive programmes for patients with chronic diseases, e.g. diabetes and heart disease. Patients are given medical devices such as glucometers or blood pressure monitors to remotely monitor their health.
- In hospitals and clinics, telemedicine is used for consultations between doctors and to conduct diagnostic tests, such as EKGs or ultrasounds, in real time.
- Patients using telemedicine can also get quick access to prescriptions, test referrals or dietician advice without having to visit a doctor.
- Telemedicine is also being used for remote palliative care, providing patients with terminal illnesses access to medical care at home.

These are just some examples of the use of telemedicine in Poland. Nowadays, telemedicine is becoming increasingly popular among patients and doctors, which can help improve the quality of health care and reduce the burden on the health care system.

A reference example from outside Europe can be found in Mercy Virtual (theMercyChannel, 2019), a virtual care centre (also known as a "virtual hospital") opened in 2015 in Chesterfield, Missouri, a suburb of St. Louis, which operates exclusively through telemedicine and is the first of its kind in the world. The $54 million facility covers an area of more than 11,500 square metres and employs more than 300 physicians who care for patients who remain in their own beds in their homes and in 38 hospitals in seven states using remote solutions. Mercy Virtual is transforming health care 24 hours a day, seven days a week, 365 days a year by creating new models of care supported by telehealth teams and technology. Patients no longer need to physically seek care or completely change their lives to access specialists. Virtual technology is bringing care to them. Such a technology-enabled hospital of the future translates into improved working conditions for medical staff and patient experience, and it also allows for lower health care costs, achieving better clinical outcomes as well as contributing to reducing the carbon footprint that was associated with the need to move both patients and clinicians.

Telehealth modalities provide an efficacious and economically-advantageous mechanism for the patient–physician interaction without necessitating geographical co-location. However, there exist several limitations and considerations; there are reports indicating its limitations or challenges related to it. For example, a survey conducted recently in India showed (apart from numerous advantages) that over 50% of the respondents report communication issues and 34% report network connectivity issues. Also, 32% of clinicians report challenges in diagnosis and medical investigations (Gupta et al., 2023). This is due to the fact that medical consultations that can be effectively executed via telehealth are not all-encompassing. Clinical encounters necessitating diagnostic imaging, blood tests, or tactile examinations still mandate in-person attendance at a medical facility.

Also, the electronic transmission of confidential patient health information poses significant security risks. Ensuring the cybersecurity of data transferred via telehealth platforms remains a prominent concern that needs ongoing attention to safeguard against potential breaches.

Lastly, although insurance coverage for telehealth consultations has expanded, particularly in the context of the COVID-19 pandemic, there remains variability in reimbursement policies. Consequently, patients may encounter unexpected out-of-pocket expenses for services that are not fully covered. Thus, while telehealth offers significant advantages in terms of accessibility and cost-effectiveness, these benefits are accompanied by challenges in diagnostic limitations, data security, and insurance reimbursement (Watson 2020).

Identifying the domain of operation

Remote telehealth consultations – or medical consultations remotely using telecommunications technology – are becoming increasingly popular around the world, also in Poland. Due to the COVID-19 pandemic, they increased in popularity, because they provided a safe and convenient way to consult a doctor without having to leave home. In some countries, such as the United States, the United Kingdom, and Australia, teleporades had become common before the pandemic, and their popularity has increased over the past few years. In some countries, such as Canada, telemedicine is recognised as one form of health care, and these services are reimbursed by the national health system. In Poland, teleportation is a relatively new form of health care, but its popularity grew significantly during the COVID-19 pandemic. In March 2020, the National Health Service launched a teleportation service for patients, which is financed by the fund. Since then, many private medical companies, such as Medicover, Luxmed, and PZU Health, have also started offering teleportation services. In Poland, teleportation is available to patients on various platforms, such as mobile apps, websites, and special telemedicine platforms. Patients can consult remotely with doctors, get medical advice, receive e-prescriptions, and perform laboratory and diagnostic tests.

Emergency care vs. permanent care

Emergency care and permanent care are two different approaches to organising health care. Acute care is an approach focused on providing rapid assistance to patients in emergencies or when they require urgent medical attention. Typically, emergency care is delivered in hospitals or emergency departments. Permanent care, on the other hand, is an approach focused on the long-term health care of patients who require ongoing care or rehabilitation. This care can be provided

in nursing homes, hospices, or specialised rehabilitation centres. These two types of care are important and necessary in health care, but they focus on different aspects of patients' needs. Acute care focuses on providing immediate emergency care, while permanent care focuses on long-term care for patients who require ongoing assistance or rehabilitation. In Poland, these two types of care are provided by hospitals, clinics, nursing homes, hospices, and specialised rehabilitation centres. Both acute care and permanent care are financed by the National Health Service or by patients using private medical services.

Examples

Telemedicine is applied to acute care in many ways, including through:

- *teleconsultation* – allows remote medical consultation, in which the doctor can assess the patient's condition and recommend appropriate treatment or further management;
- **remote monitoring** – allows continuous monitoring of the patient's condition using medical devices that transmit data to the telemedicine system, so that the doctor can react quickly if the patient's condition deteriorates;
- *emergency telemedicine* – allows rapid diagnosis and treatment in emergency cases, such as sudden heart attack, head injury, or other medical emergencies;
- *telemedicine* – allows for online medical consultations, which is especially helpful for people who are unable to go to a clinic or hospital in person.

Some examples where telemedicine is used in emergency care involve:

- the implementation of emergency telemedicine in Poland, which allows remote diagnosis and medical assistance by specialists in emergency cases;
- the use of teleconsultations to diagnose and treat patients with infectious diseases, such as COVID-19;
- the use of remote monitoring for continuous health monitoring of patients with chronic diseases such as diabetes, hypertension, and heart disease;
- the implementation of telemonitoring as part of preventive programmes, such as mammograms and colonoscopies.

Telemedicine has many applications in permanent care, especially for patients with chronic diseases that require constant monitoring and follow-up. Some examples where telemedicine is used in permanent care include:

- *remote monitoring* – enables continuous the monitoring of the health of patients with chronic diseases such as diabetes, hypertension, heart disease, or asthma. Patients use medical devices, such as blood pressure monitors or glucometers, which transmit data to the telemedicine system. This allows the doctor to monitor test results in real time and react if the patient's condition worsens;
- *teleconsultations* – allow remote medical consultations, owing to which patients can consult a doctor without having to leave home. Patients with chronic diseases often require ongoing treatment and follow-up, and teleconsultations allow for an effective management of their treatment;
- *telecare* – makes it possible to remotely provide medical assistance, such as changing medication dosages or recommending lifestyle changes. As a result, patients with chronic diseases have easier access to medical care and can respond more quickly to changes in their condition;

- *geriatric telemedicine* – enables remote medical care for elderly people who require constant health monitoring and assistance with daily activities. With geriatric telemedicine, they can have easier access to medical care while remaining at home and maintaining their independence.
- Some examples with specific applications of telemedicine in permanent care include:
- remote monitoring programme for patients with diabetes, hypertension, or heart disease, which allow for continuous monitoring of health conditions and rapid response in case of problems;
- the implementation of teleconsultations in health programmes for the elderly, such as geriatric care and home care;
- remote medical care for patients in hospices, enabling doctors and nurses to monitor patients' health and provide appropriate care in a timely manner.

Decarbonisation

Decarbonisation in health care (Health Care Without Harm & ARUP, 2021) is increasingly important due to growing environmental awareness and the need to reduce greenhouse gas emissions. The use of the Internet of Things (IoT) can help achieve this goal by introducing smart solutions that reduce energy consumption, cut waste, and reduce CO_2 emissions. One example of the use of the IoT in decarbonising health care is the use of smart lighting systems. This can optimise energy consumption and reduce CO_2 emissions. For example, hospitals can use lighting systems that respond to the movement of patients and medical staff, providing optimal lighting only when needed. Another example of the use of the IoT is the introduction of smart systems to monitor and manage energy consumption in hospitals. This can reduce energy consumption and associated CO_2 emissions by using energy from renewable sources, such as photovoltaic panels. In health care, the IoT can also be applied to waste management. Smart systems can help segregate and recycle medical waste, helping to reduce waste and the greenhouse gas emissions associated with its disposal. Another example of the use of the IoT in decarbonising health care is the use of telemedicine, which can reduce the number of trips that doctors have to make to see patients and reduce greenhouse gas emissions associated with transportation. This can also reduce the amount of energy used for transportation. The IoT sensors can be installed in medical devices, such as X-ray machines and CT scanners, to monitor their energy consumption. Based on this data, it is possible to determine when to perform maintenance or replace equipment, thus saving energy and reducing greenhouse gas emissions. The IoT sensors can also be used to monitor ambient conditions such as temperature, humidity, and lighting. In this way, air conditioning, heating, and lighting settings can be optimised, saving energy and reducing greenhouse gas emissions. Furthermore, the IoT can help reduce paper consumption through the use of electronic forms and documents. For example, patient medical records can be stored in the cloud and shared digitally, reducing the amount of paper used and reducing greenhouse gas emissions associated with paper production and transportation. The IoT can also enable the remote monitoring of patients, allowing doctors to monitor their health and prescribe appropriate treatment without the need for in-person visits. This, in turn, reduces the amount of the movement of patients and medical personnel, leading to a reduction in greenhouse gas emissions. Moreover, the use of electronic prescriptions reduces paper consumption and patient trips to pharmacies. It is also possible to monitor prescribed medications and avoid unnecessary repeat visits, saving time and reducing greenhouse gas emissions. Finally, the IoT can enable medical training and patient education to be conducted online, reducing the need for travel and reducing greenhouse gas emissions

associated with transportation. The use of the IoT in health care can help meet decarbonisation goals by introducing smart and green solutions that reduce energy consumption, reduce waste, and reduce GHG emissions (EPA, 2021).

The research method

The domain of the study is an attempt to quantitatively analyse the carbon footprint in the implementation of health care based on telemedicine. In particular, the thesis that the use of modern communication techniques can help reduce the carbon footprint is being investigated.

The importance of the topic and the purpose of the work can be demonstrated by the implementation of the CARBON programme, which standardises the monitoring of the digital footprint in many countries. The CARBON programme aims to measure the carbon footprint of health care among 2.5 million patients from seven ongoing studies from over 40 countries (Wilkinson et al., 2022). Therefore, the development of own measurement tools, metrics, and methodology for analysing the carbon footprint is an important task. Key assumptions regarding the CARBON methodology are as follows:

- Emission calculations will be based on the type and quantity of medications prescribed or sold.
- Energy-consumption-modelling software and databases will be used for life cycle assessments of medications.
- Emissions data from the Sustainable Healthcare Coalition (SHC) will be used to evaluate the carbon footprint of health care visits.

The process of developing a research model for the purposes of this quantitative study was carried out based on the methodology of Gilbert Churchill (1979). With the advent of the Internet and technological advancements, researchers now have access to a vast amount of publicly available data that can be used for quantitative analysis. The research method is in line with the main assumptions of the CARBON methodology, especially in terms of measuring the carbon footprint for medical activities. In this work, the following model of working with data was adopted:

1. determining the domain of the research – analysing the carbon footprint of medical consultation;
2. data collection;
3. data cleaning and integration to make carbon footprint data comparable;
4. exploratory analysis, allowing for the comparison of carbon footprint data with other categories and information. At this stage, numerical assumptions are made about selected aspects of health care;
5. conclusions.

The study uses publicly available data on demographics in Poland and the data of medical services in the field of telemedicine. The following data sources were used:

1. The Central Statistical Office (GUS, 2023);
2. The Ministry of Health, The Map of Health Needs (MZ, 2023);
3. Eurostat (Eurostat, 2021).

The following data was acquired from the sources mentioned above:

1. data on the number of people living in counties and voivodeships;
2. data on the number of medical services;
3. data on the number of patients registered in the health care system;
4. data on patients outside the public health care system;

5. data on the number of ambulatory care services (ACS) and primary care services (PcS) teleconsultations in 2020–2021, broken down by voivodeships;
6. population forecasts for the years 2023–2050, broken down by counties and voivodeships;
7. Eurostat data on CO_2 emissions.

After the relevant data was identified, downloaded, and integrated, it was processed to ensure that it is suitable for analysis. This involved checking for errors, missing values, and outliers. The data also was cleaned, transformed, and formatted into a single tabular structure. This step is critical in ensuring that the analysis is accurate and unbiased. At this stage, additional calculated measures and percentage ratios were determined (Table 2).

The obtained data has different levels of detail, different time ranges, and different completeness. In order to integrate the data, it was assumed that the unit of analysis is a voivodeship, and the time granularity is one year.

The next stage of the research is exploratory analysis and data visualisation. For this purpose, we used the following IT tools for data analysis: the Python Excel and the PowerBI. A monthly list of patients enrolled into full years in a given entity providing primary care services was included. Two health care entities have been analysed: a medical entity providing services in the field of primary health care as well as night and holiday health care. The study is rooted in the ICD-10 medical care classification (WHO, 2022). Due to the nature of the data, the analysis has some limitations. Some experts question the legitimacy of using the ICD-10 system in primary health care. In addition, reporting to the National Health Fund makes it possible to report only one diagnosis code for the identification of one service, which by definition may cause interpretation limitations. In particular, during a single visit, a patient may produce several ICD-10 codes, which can be confusing. However, patient with allergies, conjunctivitis, and requiring a prescription drugs will, in fact, use several care services.

Once the data analysis is complete, the results are to be interpreted to draw meaningful conclusions. This involves analysing the output and determining the significance of the findings. They are evaluated in the context of the research question and the literature.

Data exploration

The COVID-19 pandemic brought about an important transformation in health care services, especially in the field of telemedicine. Telemedicine is the use of technology to deliver medical services and health care remotely, and it became a crucial tool for providing medical care during the pandemic. With social distancing measures and restrictions on in-person health care visits, telemedicine became an important means of maintaining patient care. The use of telemedicine has been particularly valuable for high-risk patients and those with chronic conditions who require regular checkups and monitoring. The pandemic also allowed for the development of technologies related to remote health care, such as video consultations or remote monitoring devices. The development of telemedicine during the pandemic has undoubtedly revolutionised the health care industry, providing a convenient, cost-effective, and efficient means of delivering medical care that is likely to continue even beyond the pandemic era.

During the analysis, based on the available data, the following indicators were determined (key indicators are presented in Table 2):

1. population: baseline and projections;
2. average CO_2 emissions in road transport;

3. average distances from health services;
4. indicators regarding the number of teleconsultations and the selected category of basic service;
5. the number of teleconsultations to population (percentage).

The above indicators allow the estimation of the future potential of teleconsultations and other services that can be provided using telemedicine services. Based on the population forecast for the years 2021 to 2050, the number of medical services provided remotely was estimated.

It is worth noting that data on the number of the citizens for the specific years was prepared by taking the results of the census as the starting base for a given area (voivodeship), and then making estimates using the balance method. Balance method takes into account live births, deaths, and migration balance recorded that year. The number of citizens in Poland includes two categories of population:

1. people permanently living in a specific area;
2. people staying temporarily for more than 3 months in a specific place.

The analysis did not take into account the age of the society and the fact of the ageing of the population (Fig. 1). This factor may significantly change the structure of future medical services. However, taking into account the purpose of this study and the adopted unit of analysis (voivodeship), such a simplification does not significantly affect the analysis of the carbon footprint reduction potential in the health service.

The demographic structure of Poland is presented in Figure 2. Its dynamics indicate the ageing of the society in the coming decades. Figure 3 shows the age (and sex) distribution expected in 2040. An ageing population brings various challenges to the health care system, resulting in higher costs and CO_2 emission. For example, one can expect increased demand for medical care as older people use medical services more frequently, which increases the burden on the health system. Moreover, with increasing age, the risk of chronic diseases such as diabetes, cardiovascular disease, and cancer increases. Treatment of these diseases is often expensive and long. Also, the need for long-term care services, such as nursing homes and hospices, increases with age.

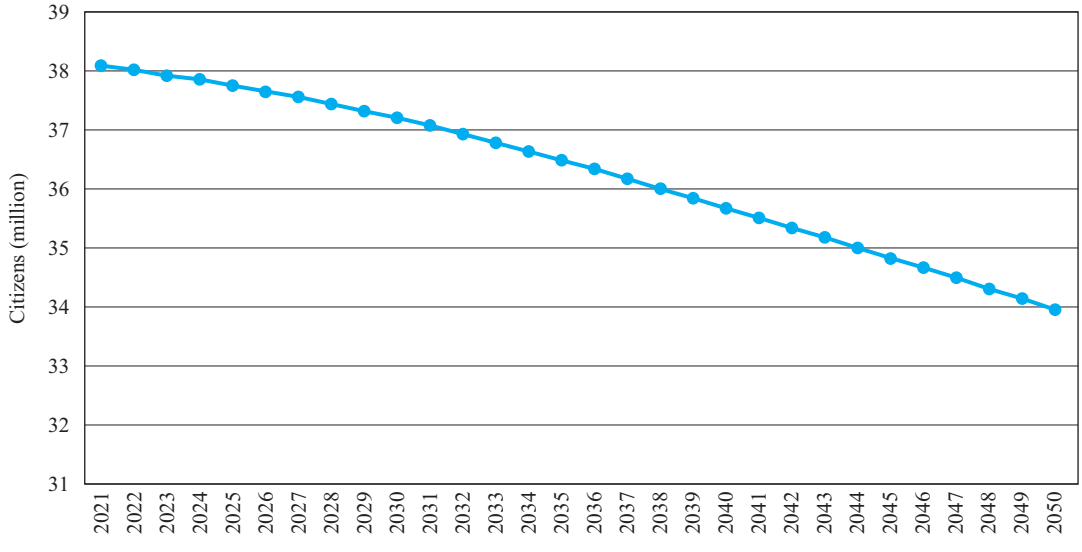


Figure 1. Predicted number of citizens in Poland from 2021 to 2050

Source: Own study.

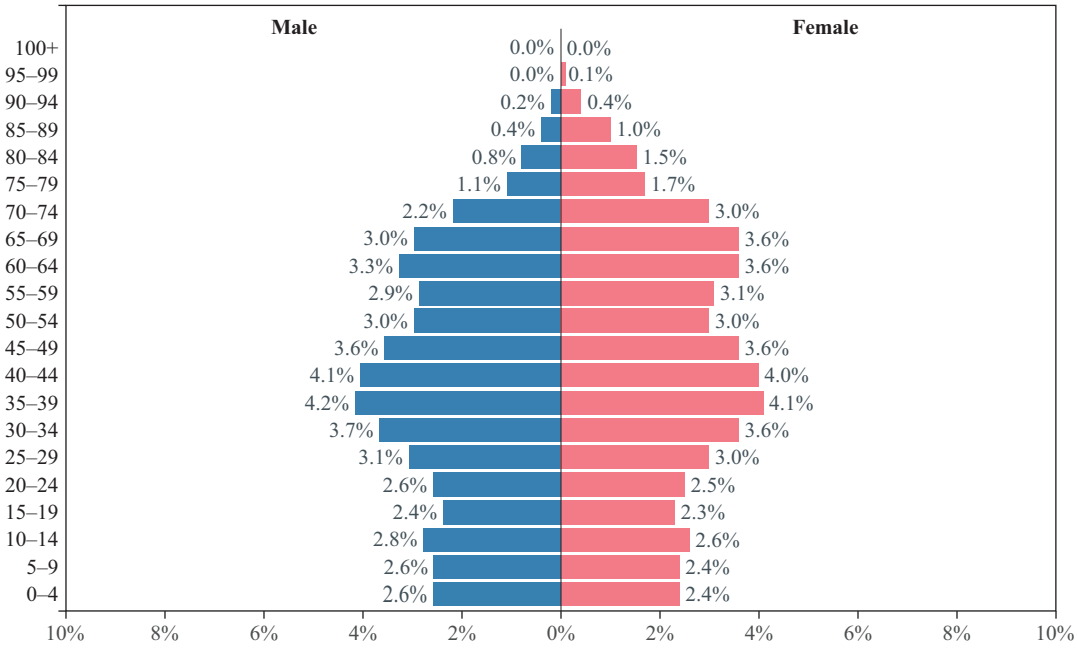


Figure 2. Age structure in Poland in 2021

Source: https://www.populationpyramid.net/

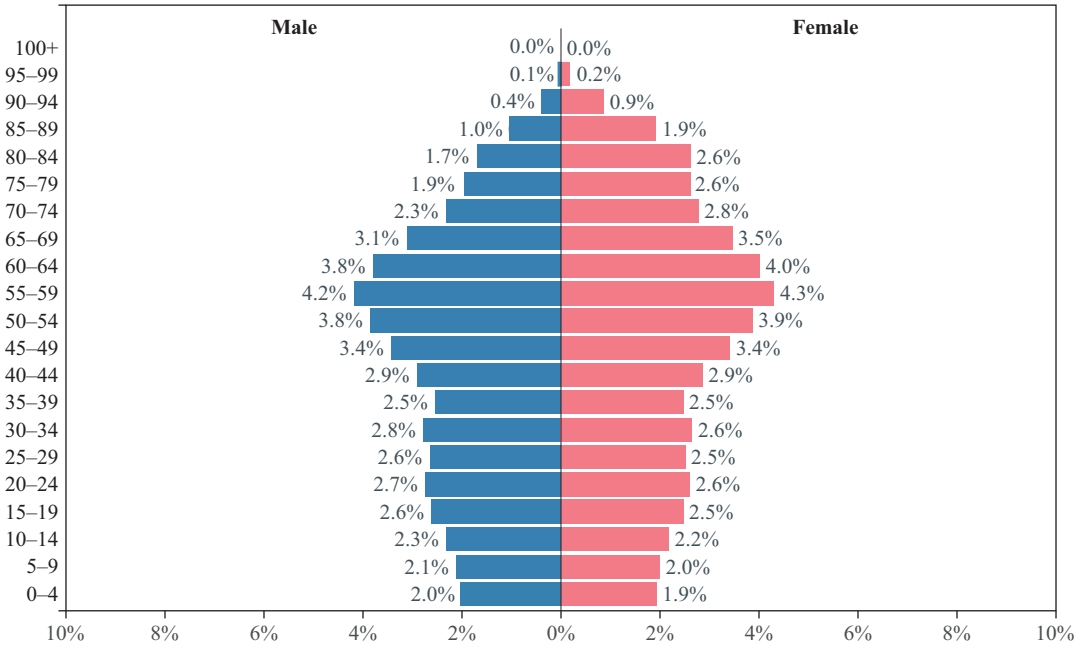
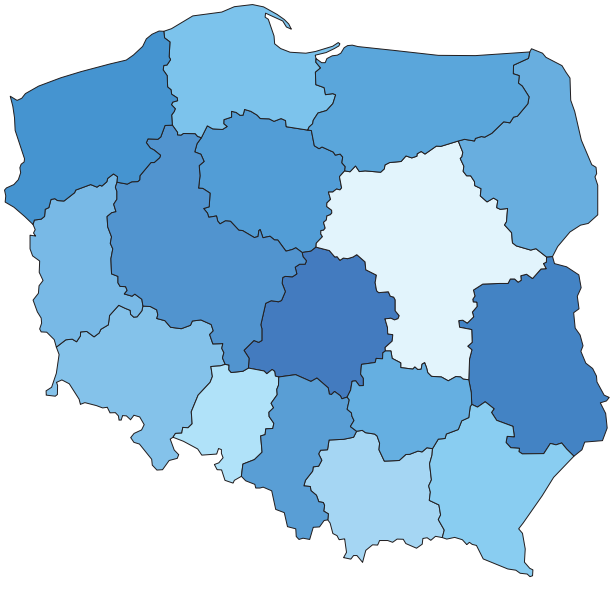


Figure 3. Predicted age structure in Poland in 2040

Source: https://www.populationpyramid.net/

Based on the historical data of the Ministry of Health, the number of basic health care services in each voivodeship was determined in relation to the number of inhabitants of a given voivodeship (Fig. 4). This measure was averaged for the whole of Poland and over time (for 2020 and 2021). The averaged indicator was used to estimate future values of the number of medical services.

In mathematical terms, the study does not take into account the factor of ageing society, although it was included in qualitative terms and in the formulated conclusions. It can be argued that the ageing of the population will generate greater needs in the field of health care. As a consequence, CO_2 emissions will increase.



Voivodeship	Services indicator
dolnośląskie	4.15
kujawsko-pomorskie	4.46
lubelskie	4.71
lubuskie	4.25
łódzkie	4.70
małopolskie	3.99
mazowieckie	3.80
opolskie	3.96
podkarpackie	4.12
podlaskie	4.31
pomorskie	4.20
śląskie	4.43
świętokrzyskie	4.34
warmińsko-mazurskie	4.41
wielkopolskie	4.52
zachodniopomorskie	4.56

Figure 4. Number of health care services for one citizen in Poland in 2021

Source: Own study.

The spatial distribution of accessibility from the place of residence to the nearest primary health clinic, expressed in a unit of distance, results directly from the location of these facilities. The Śląskie and Dolnośląskie Voivodeships are characterised by the best accessibility – 59–62% of people aged up to 17 and 64–67% of adults live here within 1 km of the clinic. For south-eastern voivodeships (Małopolskie, Podkarpackie, Lubelskie, and Świętokrzyskie) this percentage is the lowest – for children and teenagers it is 38–42%, and for adults – 43–46%, respectively. In cities, the average distance to this service is about 0.8 km, while in the countryside it is 3.4 km. About 75% people in cities live less than 1 km from a clinic – 75% of children and 79% adults. In rural areas, these percentages are 17.3% and 18.2%, respectively. Over 36% of people living in rural areas have at least 4 km to a clinic, including 13% with at least 6 km (Ajdyn, 2018). The study assumes that the average distance of a patient to a primary health care facility is 5.5 km. Thus, the total distance is 11 km (to and from the facility).

Based on this data, an indicator of the average number of primary health care services per citizen can be determined. The indicator was determined by dividing the average number of health

services by the number of flats in individual voivodeships. The results determined this way were averaged, obtaining the result of 2.9 services per citizen for 2020 (Table 2).

The distance from the health care facility may vary significantly, depending on the specialisation of the medical visit. While the distance to a primary care physician is several kilometres, access to a specialist may require travelling to distant urban centres, i.e. several dozen or even several hundred kilometres away (Wootton et al., 2010).

Total CO_2 emissions from road transport are planned at 59 Mt in 2030 (an increase of 78% compared to 2005) and 51 Mt in 2050 (Rabiega & Sikora, 2020). The reduction of CO_2 emissions is realised on many levels. It concerns the implementation of electric vehicles, the development of public transport, and operational domain activities. The average CO_2 emission of passenger cars (new) in Poland in 2020 was 121g CO_2/km (Fig. 5). However, older cars have significantly worse emission parameters.

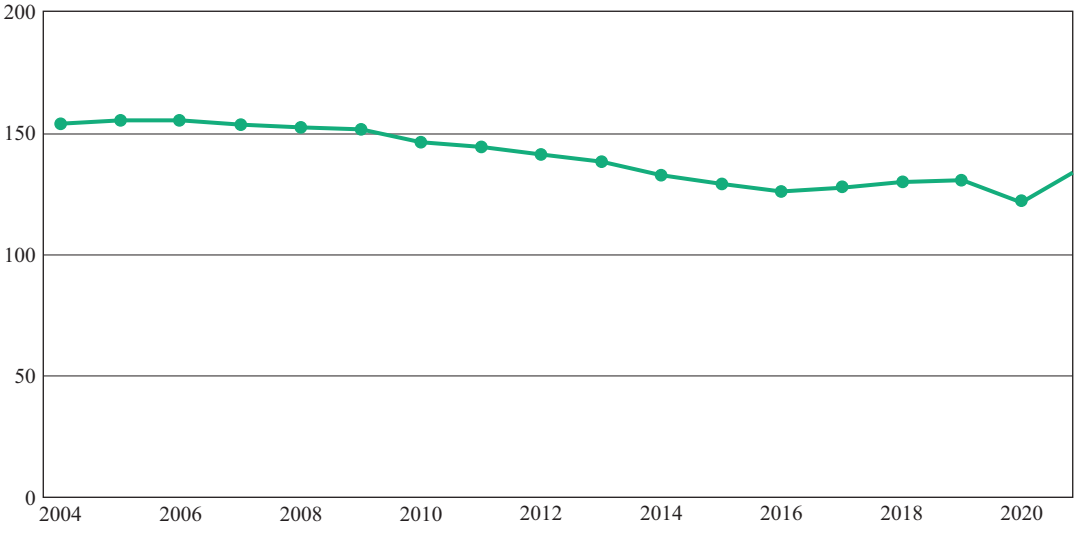


Figure 5. Average CO_2 emissions per km from new passenger cars in Poland

Source: Eurostat.

Different studies report different levels of CO_2 emissions during medical visits. For example, travelling 15 km by car produces 2.93 kg of CO_2 (Connor et al., 2019). Calculating travel distances from home addresses, also taking into account the mode of transportation and vehicle specifications, the mean saving was 39.3 km, equating to 8.05 kg CO_2 per medical consultation (Purohit et al., 2021). In turn, studies on the distances travelled to a medical facility assume slightly more optimistic emission indicators, namely at the level of 97–107g CO_2/km (Table 1). However, it should be taken into account that the emissivity depends on many elements, e.g. the terrain of the study area may cause significant changes in CO_2 emissions, while upland and mountainous areas tend to emit more pollutants (then, CO_2 levels can be as high as 152 g/km) (Vidal-Alaball et al., 2019).

In this study, we assume that the average emission of carbon dioxide per kilometre of car travel is 99 g CO_2/km. Thus, it can be calculated on average that one medical consultation results in 1.1 kg of CO_2 emissions (Table 2).

Table 1. Distance and average CO_2 emissions by car in selected studies

Travel distance [km]	CO_2 emission per consultation [kg CO_2]	CO_2 emission per 1 km [g CO_2]	Source
39	8.1	103	(A. Connor et al., 2011)
15	2.9	98	(M. J. Connor et al., 2019)
18	3.6	98	(Miah et al., 2019)
111	22.0	99	(Oliveira et al., 2013)
21	3.3	76	(Vidal-Alaball et al., 2019)
126	26.9	107	(Wootton et al., 2010)

Source: Own study based on (Purohit et al., 2021).

Another approach involves the analysis of all therapy and patient care, using remote means. For example, comprehensive life cycle assessment (LCA) was carried out in Sweden to estimate the carbon footprint of the telemedicine equipment (Holmner et al., 2014).

Table 2. The main assumptions and metrics of the study

Metric	Value	Source
Average distance to a healthcare facility	5.5 km	(Ajdyn 2018)
Average CO_2 emissions/km	99 g	(Oliveira et al. 2013)
Average CO_2 emission per one medical consultation in the facility	1.1 kg	11km x 99g
Average number of primary care services per person	2.9	
The percentage of teleconsultations among medical consultations	25%	
Percentage of prescription renewals among medical consultations	41%	
Percentage of consultations on behalf of another person among all medical consultations	5%	

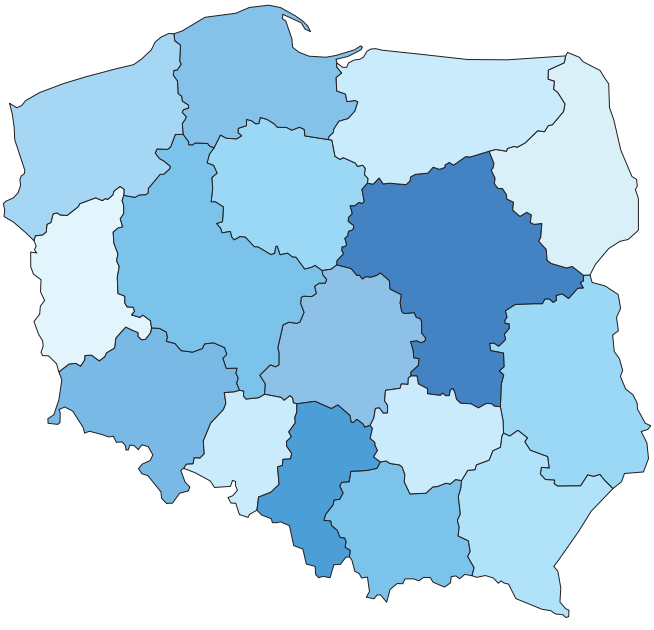
Source: Own study based on literature review.

In Poland, in 2021, over 39 million remote visits were carried out. Taking into account the population of the country, once numerous patients were registered, it constitutes 24% of all services provided in this period (Fig. 6 and 7). For further analyses, it was assumed that 25% of medical services are teleconsultations (Table 2).

The years 2020 and 2021 covered the period of the pandemic and the greatest restrictions related to movement and public gatherings. In those years, respectively 0.3 and 1 consultation per person were carried out (in relation to the number of inhabitants of the country). Taking into account the projected population and the corresponding number of health services, it can be assumed that the number of teleconsultations in 2040 will be at the level indicated in Figure 8.

It is worth noting that a significant number of medical services provided as part of primary health care include renewals of prescriptions and consultations on behalf of another person (2.8 million in 2020 and 1.7 million in 2021). Both categories, if properly managed, could be successfully implemented remotely to a large extent. Saving time, reducing patient service costs, or reducing pollution caused by commuting to a medical facility can certainly bring measurable

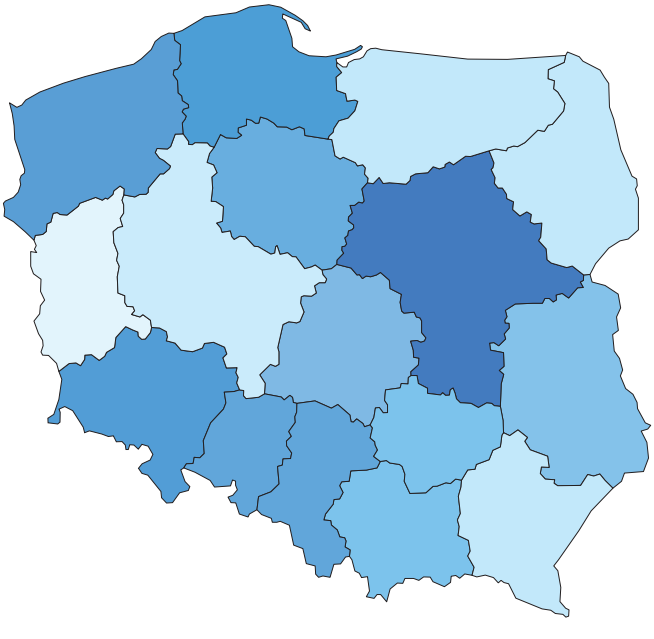
benefits, especially in the long term, when telemedicine and the use of the IoT will be used systemically in health care.



Voivodeship	Telekonsultations (POZ)
dolnośląskie	3,243,435.00
kujawsko-pomorskie	2,265,594.00
lubelskie	2,254,961.00
lubuskie	781,653.00
łódzkie	2,668,714.00
małopolskie	3,175,463.00
mazowieckie	6,213,484.00
opolskie	994,013.00
podkarpac kie	1,707279.00
podlaskie	971,986.00
pomorskie	2,705,874.00
śląskie	5,069,012.00
świętokrzyskie	1,235,406.00
warmińsko-mazurskie	1,213,040.00
wielkopolskie	3,084,202.00
zachodniopomorskie	2,008,020.00

Figure 6. Number of teleconsultations in Poland in 2021

Source: Own study.

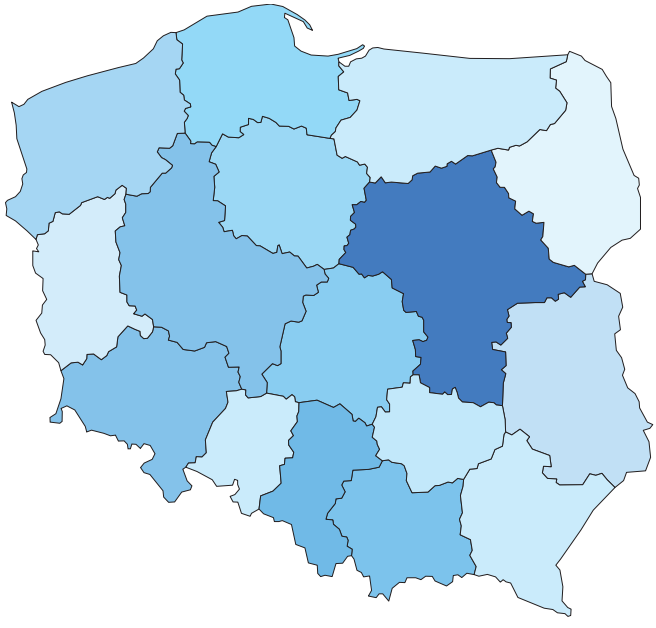


Voivodeship	Teleconsultations percentage
zachodniopomorskie	26,26
wielkopolskie	19.54
warmińsko-mazurskie	19.57
świętokrzyskie	23.50
śląskie	25.68
pomorskie	27.46
podlaskie	19.36
podkarpackie	19.64
opolskie	25.91
mazowieckie	30.20
małopolskie	23,33
łódzkie	23,48
lubuskie	18,41
lubelskie	23,04
kujawsko-pomorskie	24,81
dolnośląskie	27,11

Figure 7. Number of teleconsultations in Poland in 2021 as a percentage of all medical services

Source: Own study.

In this paper, we point out that the use of innovative remote health care tools can also help reduce the carbon footprint of some medical services.



Voivodeship	Telekonsultations (POZ)
zachodniopomorskie	2,573,481.77
wielkopolskie	3,801,617.47
warmińsko-mazurskie	1,158,159.21
świętokrzyskie	1,425,903.39
śląskie	4,275,887.21
pomorskie	2,890,932.76
podlaskie	700,304.65
podkarpackie	1,368,855.13
opolskie	1,135,789.65
mazowieckie	8,245,380.08
małopolskie	3,896,051.54
łódzkie	3,141,934.76
lubuskie	818,510.90
lubelskie	1,394,604.16
kujawsko-pomorskie	2,699,006.90
dolnośląskie	3,500,695.67

Figure 8. Predicted number of teleconsultations in 2040

Source: Own study.

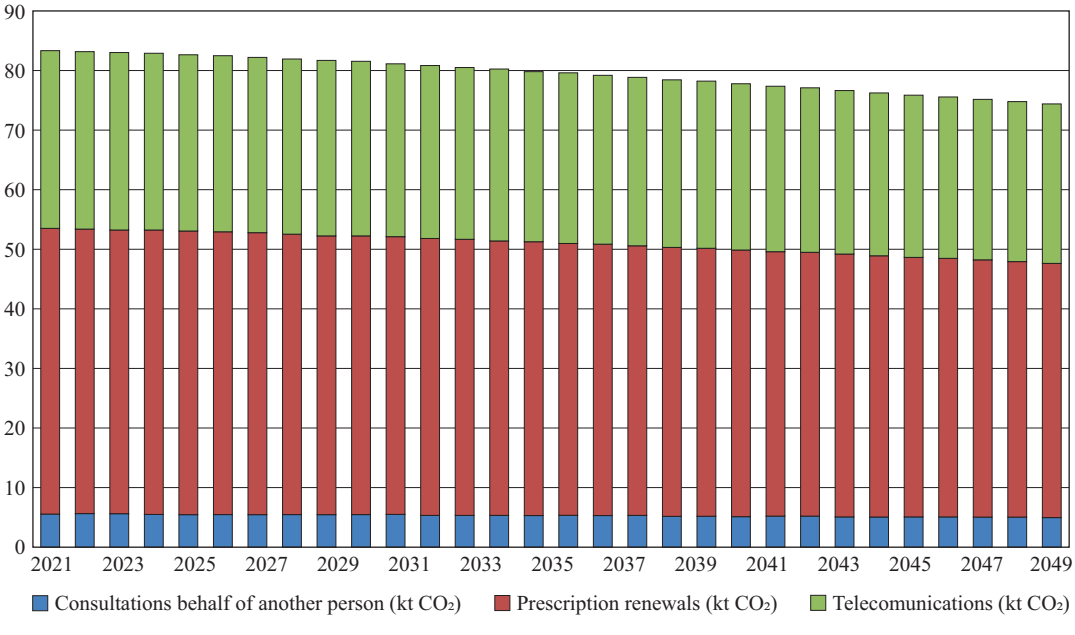


Figure 9. Projected amount of CO_2 reduction in kilotons per year

Source: Own study.

Consultations on behalf of another person account for approximately 5% of all services provided as part of primary health care. Prescription renewals account for over 40%. For further analyses, we assume that 5% are consultations on behalf of another person and 41% of all medical services are prescription renewals (as presented in Table 2). Assuming that the level of teleconsultations (i.e. their percentage in relation to the total number of services provided) will be constant over time, three forecasts of the possible reduction of the carbon footprint were presented, coming from car trips to a health care facility. Potential CO_2 savings can be made in three categories. Taking into account the dynamics of Poland's population over time, the estimated CO_2 reduction will be as indicated in Figure 9.

When analysing the potential reduction of the carbon footprint by means of IT and video systems, it should be related to the carbon footprint produced by these systems. For example, a study in Sweden (Holmner et al., 2014) used a ‚cradle-to-grave' life cycle assessment (LCA) to evaluate the carbon footprint of videoconferencing equipment. The study concluded that the carbon footprint from telemedicine equipment is relatively small (1.86–8.43 kg CO_2/hour) compared to car travel for in-person visits (87.4–176 kg CO_2 saved per consultation). Carbon footprint reported in the University of California, Davis Health System's outpatient telemedicine service, reports savings of total of 1,969,000 kg CO_2 across 19,246 consultations (Dullet et al., 2017).

There are some limitations in comparing different results, as some studies did not account for the travel distances of health care professionals. For example, a study in Scotland (Wootton et al., 2010) found that videoconferencing in nurse-led minor injuries units avoided unnecessary transfers, saving an estimated total of 260,000 km of travel, or 26.9 kg CO_2e per consultation. Some studies have looked at cost-effectiveness per consultation, with different assumptions being made to determine the environmental cost of consultation. Other studies operate on aggregated data, which can then be averaged per consultation, and still others are based on the number of travel kilometres saved during the Internet or telephone communication.

Conclusions

The study reported that the use of telemedicine services leads to a reduction in the carbon footprint of health care. The health care sector is responsible for about 4.4% of global greenhouse gas emissions, which indicates that the exploration of this area is important for emissions of GHGs. The relationship between the carbon footprint and the average travel distance is known and strong. Many CO_2 emissions reductions come from a reduction in travel to on-site consultations. We suggest that telemedicine should play an increasing role, especially in an ageing society that will require more medical consultations over time.

In weighing the results of this study, several limitations should be considered. First, the applied research method does not allow for the generalisation of the research. In particular, the analysis does not take into account the dynamics of demographic changes in society. However, some regularities and guidelines may be indicated as valuable, even despite this limitation. The second limitation of the analyses is the use of private care by patients. In addition, the patient's place of residence may not correspond to the reality, because it is based only on his/her declaration, which, in turn, is submitted relatively rarely.

The directions of further research result from the limitations of this study. Further research should focus on two areas:

- an analysis of future medical needs, taking into account demographic dynamics and using innovative telemedicine tools;
- the use of modern methods of communication and medical diagnostics in remote patient services.

Despite the indicated limitations, the study brings specific numbers and indicators that not only show the state of the health care carbon footprint today, but also indicate the future values of selected indicators. The essence of the study is to base it on relatively simple assumptions, the modification of which might increase the dynamics of analyses with the scenario-based approach.

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Katarzyna Sułek

Integrated Safety Management for Mass Arts and Entertainment Events Based on an Outdoor Concert in Poland: A Case Study

Abstract

Objective: This article aims to conduct a detailed analysis of the activities carried out within the framework of integrated safety management of a specific arts and entertainment event. Moreover, it seeks to verify the hypothesis that the security sequence applied during the individual phases of the event, based on changes in the number of security and information services, ensures an appropriate level of safety for the participants.

Research Design & Methods: The study utilised a case study methodology in conjunction with in-depth interviews and document analysis techniques for data collection and analysis. The utilisation of this diverse array of research methods facilitated the acquisition of a holistic understanding of the processes that support the maintenance of public order during the event. Additionally, it enabled the evaluation of the practical effectiveness of integrated security management.

Implications/Recommendations: The implications of this study extend to the realm of public governance. It highlights the need for robust regulatory frameworks to effectively manage mass events. The law plays a crucial role in establishing guidelines and standards for ensuring participant safety and public order. Moreover, effective coordination between different stakeholders, including event organisers, security services, and information providers, is essential to achieve an appropriate level of safety.

Contribution/Value Added: This article contributes to the understanding the importance of integrated safety management in mass events and its implications for entities organising mass events. It provides valuable insights into the processes and measures necessary to maintain public order and ensure participant safety. By addressing the gaps in knowledge regarding safety management systems for mass events, it offers recommendations for policymakers, event organisers, and other stakeholders involved in public governance.

Keywords: mass events, safety management, integrated safety, event organisation, integrated security management, public safety

Article classification: research article

JEL classification: L82

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Introduction

Each year, the number of mass event supporters increases significantly. This is because such occurrences are treated as a cultural good, displaying a universal character both in the eyes of the public as well as on the grounds of the Constitution (Constitution of the Republic of Poland, 1997, Article 6). A diverse array of event types comprises a broad spectrum, encompassing at least eleven distinct ‚genres,' which span from business and festivals to social gatherings and sports events (Berridge, 2020, p. 273). They play an important role in social, cultural, and political life (Ziakas & Costa, 2011). Their diverse nature has a special effect on participants, making them feel part of an extraordinary spectacle, evoking emotions ranging from excitement to despair, from sadness to euphoria.

Understood in the context of an open, dynamic, and socio-technical system, a mass event enables the achievement of an objective, measured by the degree of satisfaction of its participants, which not so much depends on the success of the show itself, but is a result of social and living conditions, respect towards guests and the environment, as well as safety in general (Szymonik, 2011, p. 322).

Safety is one of the basic human needs, and its absence instills a sense of insecurity in the individual, resulting in reduced trust in both subjective and objective factors. Consequently, organisers are constantly taking measures to ensure incident-free mass events. This obligation stems from the law, precisely regulating any type of issue that could affect public order (Rosa & Cabandié, 2018), putting at risk the life or health of the participants of the event in question.

Safety management of mass events is, therefore, implemented by ensuring a state of security, resulting from the fulfilment of certain statutory requirements, guaranteeing an authentic sense of safety, perceptible by the participants, granting the possibility of tranquil participation in the event (Kąkol, 2018, p. 189).

The purpose of this article is a detailed analysis of the activities carried out within the framework of integrated safety management of a specific arts and entertainment event, taking into account a number of processes conducive to maintaining public order within the event area. Thus, it enables the verification of the hypothesis that the security sequence applied during the individual phases of the event, based on changes in the number of security and information services, was developed in a manner ensuring the appropriate level of safety for the participants of the event. The rationale behind the choice of the above topic is directly linked to the development of safety management systems for mass events and the renaissance that sports matches, concerts, and music festivals are experiencing after the SARS-Cov-2 pandemic.

Literature review

The safety of mass arts and entertainment events in Poland

The legal act regulating the safety of events of a mass character is the Act of 20th March, 2009, on the safety of mass events, according to which an event of an artistic or entertainment nature, including a television broadcast on screens meeting certain technical parameters, is generally considered to be an arts or entertainment event. One must bear in mind that in order for a given event to obtain this title, the number of its participants must exceed 500 (if the venue is a closed facility such as a sports hall) or 1000 (in open-air facilities) (Safety Act, 2009, art. 3, point 2).

Depending on their size, events have a specific impact on their surroundings. Local events require a different level of commitment from public authorities than regional or national events. Moreover, the organisation of mass events is not possible without the participation of three stakeholders – public, private, and social, cooperating simultaneously at several levels, among which the most important one is ensuring the safety of people, both those actively and passively involved in the event (Parszowski & Kruczyński, 2015, p. 16).

The organisers of this type of event are, therefore, obliged to maintain public order by taking measures to counteract problematic situations (Kostrubiec, 2021, p. 116), including acts of violence and aggression, and to provide medical assistance for the event, if such a need should occur. These obligations mainly include the preparation of hygiene and sanitary facilities and the organisation of a communication system between the entities securing the event, as well as the provision of the necessary equipment aimed at securing the event in terms of rescue and firefighting activities and the marking of evacuation routes, including routes making way for rescue services and the police.

The organisers of mass events are also obliged to undertake actions aimed at appointing a safety manager and selecting and determining an appropriate number of security services whose task is to maintain public order, as well as information services aimed at keeping the participants informed about the adopted organisational solutions (Safety Act, 2009, Article 19, points 1–2). The coordination of the above activities, with particular emphasis on the determination of the number and stationing of security and information services, together with the ongoing supervision over the course of a given event, is referred to as mass event safety management.

The number of the mentioned services depends on the status of the mass event. Events not classified as mass events of higher risk are characterised by the allocation of at least 10 members of security and information services in total for every 300 participants, and at least 1 member of the services for every additional 100 persons, assuming that the members of the security services constitute at least 20% of their total number. On the other hand, in the case of events bearing the name of mass events of higher risk, the appropriate number of security and information services is no less than 15 members for every 200 participants and at least 2 representatives of the services for every additional 100 persons, provided that the members of the security services should constitute at least 50% of all the persons present at the event who are responsible for maintaining public order (Safety Act, 2009, Art. 6, point 2).

The standard locations of security service posts include entrances and exits, car parks, stands, the stage, the pitch, as well as the catering area and communication routes. However, the determination of the actual stationing of the services is updated on an ongoing basis, showing a direct link to the phase of the mass event and the resulting changes in the number of participants of the event, functioning under the concept of dynamic stewarding (Polish Football Association, 2019, p. 10). The safety management of an arts and entertainment event, centred around ensuring adequate numbers of security and information services, should, therefore, follow the three essential phases of the event, shown in Table 1.

In the occurrence of events that cause public order disturbances and may lead to injuries of event participants, the organisers are also obliged to provide appropriate medical assistance for the event, in accordance with the Regulation of the Minister of Health of 6th February, 2012, on the basic requirements for medical assistance of a mass event.

The process of medical assistance provision is ongoing, starting with the official start of the event and ending with the departure of all spectators from the venue and its consequent

closure to unauthorised persons. The cited regulation also lays out a number of guidelines relating to the required qualifications of personnel, the maintenance of proper attire and the necessary equipment at medical points, and in the case of mass events with more than 10,000 participants, obliges organisers to appoint a medical coordinator, reporting directly to the safety manager, responsible for the development of an appropriate plan for the medical provision of the event and ongoing supervision of the activities of medical services, including ambulance teams, rescue patrols, and medical assistance points (Regulation of the Minister of Health, 2012, §1–5).

Table 1. The stationing and duties of security and information services during different phases of a mass arts and entertainment event

Setting	Location of safety services	Tasks of the security services	Tasks of the information services
Pre-concert	• entry and exit gates, • car parks, • traffic routes.	• supervising the safety of participants entering the mass event area, • checking participants' identification, • implementing security screening of the individuals, • vehicle inspection.	• supervising the safety of participants entering the mass event area, • ongoing enforcement of the event regulations, • directing the audience to the right places, • providing necessary information, • assisting people with disabilities.
Concert	• sectors, • pitch, • stage, • sanitary and production facilities, • traffic routes.	• preventing overcrowding, • ensuring the safety of artists and staff, • giving instructions for the maintenance of public order of the mass event, • demanding persons disrupting the event to leave the area of the mass event, • detaining individuals whose behaviour endangers the health and life of the event participants and handing them over to the police.	• providing the necessary information, • referring to medical, sanitary and catering facilities, • in the event of danger, taking the necessary precautions and informing security services of the situation immediately.
Post-concert	• sectors, • pitch, • entry and exit gates, • car parks, • traffic routes.	• indicating the nearest exit route, • directing traffic in car parks, • checking the site for any damage, • final inspection round.	• indicating the nearest exit route, • directing traffic in car parks.

Source: Own elaboration.

The safety management of mass events is an ever-evolving process, requiring ongoing supervision and the implementation of a number of tasks that exhibit a varied nature from one phase of the event to the next. However, the development of procedures alone may not be sufficient. What is important is their proper implementation and adaptation to the dynamically-changing environment. This requires event organisers to present not only sound planning and coordination, but also a high organisational culture and experience. In order to guarantee the highest level of safety for participants, it is, therefore, necessary to include qualified professionals and services

responsible for ensuring safety and public order in the organisational process, whose ongoing cooperation enables achieving the synergy effect (Marjański & Ropęga, 2019, p. 68).

Integrated safety management for mass events in Poland

In recent years, there have been significant changes in the approach to managing safety at mass events. Until now, the focus had been mainly on confrontation-oriented activities, countering the occurrence of public disorder. However, the importance of other threats and the connection between the safety level and other organisational elements had been overlooked. A model assuming a comprehensive integration of the three main components – safety, security, and service (Parszowski & Kruczyński, 2015, p. 16), presented in Table 2, is brought forth alongside the concept used so far.

Table 2. The components of the integrated safety management for mass events

Safety	Service	Security
An efficient and effective information policy	Comfort of the participant during the mass event and concern for his/her well-being	Professional security plan
Modern infrastructure	Professional organisation and logistics of the event	Integrated, ongoing risk analysis
No fences or railing around sectors	Convenient access to the facility enabling the venture to take place	The use of police operational information
Appropriate signposting of the mass event area	Professionally prepared parking	Security for everyone (participants, journalists, etc.)
Integrated management and developed contingency plans	Programmes for participants of the mass event	Ongoing surveillance to prevent negative events
Security screening at the entrances	Professional Stewards	The segregation of participants based on risk analysis
Crowdflow management	Friendly facilities l' buffets, sanitary facilities, etc.	Crisis plans
The interaction of Police and Stewards with participants	Entertainment – accompanying events	The prevention of terrorist threats
Emergency medical services	Efficient and friendly service	Reducing the participation of violent and aggressive people

Source: Adapted from Parszowski & Kruczynski, 2015, p. 17.

Integrated safety management of mass events is, therefore, an approach combining all areas of management, with the aim of ensuring proper security of the event and minimising the risks associated with the organisation of mass events, focusing on the updated and effective flow of information, the coordination of the activities of the entities involved in the organisation of the event, and the creation of an environment conducive to multi-stakeholder cooperation. This concept, extending the notion of classic mass event safety management to include activities beyond ‚putting out the fire', is based on project management, introducing the division of the venture into smaller projects, the implementation of which is determined by the availability of human and financial resources as well as the time perspective (Sabat, 2017, p. 122).

The approach presented was initially applied during the preparations for the Final Tournament of the UEFA EURO 2012 European Football Championship. The success of the security measures executed during that period was significantly dependent on meticulous planning and seamless collaboration. This encompassed a comprehensive analysis and risk assessment of the services and security forces involved. Furthermore, it entailed continuous coordination and diligent oversight of these service activities (Falkowski & Liberek, 2019, p. 10).

Subsequently, in the course of the 2012 Olympic Games in London, initiatives founded upon the principles of integrated safety management were undertaken, yielding a range of notable outcomes. This encompassed the effective coordination between private security personnel and volunteers to oversee the orderly movement of participants. Additionally, measures were implemented to establish both human and physical barriers, thereby ensuring adherence to prescribed routes and pathways while maintaining event safety (Ludvigsen & Hayton, 2022, p. 138).

Gaining more and more popularity, the concept of integrated safety management for mass events has in a way become a standard applicable in the implementation of various types of ventures all around the world.

Research methodology

An effort to implement the concept of integrated safety management for mass events was undertaken by one of the cultural centres in the Świętokrzyskie region. This initiative revolved around the organisation of an outdoor concert, which serves as the central reference point for this case study.

This approach facilitated a comprehensive analysis of the practical implementation of integrated security management within a specific artistic and entertainment event. By immersing into the specifics of this individual case, it became possible to scrutinise and gain insight into the actions and protective measures that were instituted across various phases of the event. The case study, therefore, furnishes both context and intricate data, affording a profound comprehension of the contributing factors to safety management in practical application, as well as whether the sequence of actions employed genuinely underpins the assurance of safety during an artistic event.

The research method enabling the collection of data on the implementation of the presented approach was an in-depth direct interview. Here, respondents are allowed to express themselves freely based on the associations and facts related to the process of organising mass events (Guion et al., 2011, p. 1). In addition, internal documents were used as research material (Bowen, 2009, pp. 27–28), enabling a thorough analysis of the methodological aspects of security management. The applied research approach, which is a combination of data collection techniques, provided a comprehensive and thorough understanding of the idea of the integrated safety management of mass events.

In accordance with the methodology of organising mass events presented by employees of the cultural centre in a direct interview, the implementation of the above-mentioned concept began with the development of relevant documents, which included instructions on security service procedures, a graphic plan of security, the event script, rules and regulations of the event, instructions on how to behave in case of a fire or other local hazard at the place and time of the mass event, the schedule of opening and closing the event area to the participants, as well as the communication conditions between the entities taking part in securing the mass event.

The documentation prepared made it possible to request a relevant statement from the District Police Headquarters, Fire Brigade, Sanitary Inspection, as well as the Medical Rescue and Sanitary Transport Centre. A letter was also sent to the Healthcare Facility, informing them of the concert hosting several thousand participants, in order to for them to prepare the medical services for any unforeseen circumstances that might arise during the event, necessitating the admission of a large number of patients.

At the same time, an identical set of documents, supplemented with information that the statements of the above-mentioned institutions had previously provided, was presented to the Mayor of the City. The obtained rulings were then delivered to the Department of Civil Affairs at the City Hall, granting the permission to organise a mass event.

Obtaining the approvals initiated making the process of organising the outdoor concert a reality. This resulted in the need to determine the planned number of people taking part in the three main phases of the event, established by the Organiser on the basis of the number of participants, using a different criterion of division than that proposed by the author of this publication.

Conducted forecasts predicted that in the first phase of the mass event, the number of interested persons would reach 1,000, in the second – 3,000, while in the third phase, the total number of participants would oscillate around 8,000. The rotation of guests entailed the necessity of an ongoing increase in the number of security and information services, whose number in the culmination of the event reached 87 persons. This figure was determined on the basis of guidelines derived from the Act of 20th March, 2009, on the safety of mass events.

A summary analysis of the number of services in the different phases of the mass event, taking into account the planned number of participants in the event, is presented in Table 3.

Table 3. The phases and number of security and information services during the outdoor concert

Phase	Time interval	Number of participants	Occupied area	Number of services		
				Security	Information	Total
Phase I	15:00–17:00	1,000	500 m^2	4	13	17
Phase II	17:00–19:00	3,000	1,500 m^2	8	29	37
Phase III	19:00–23:30	8,000	4,000 m^2	18	69	87

Source: Own elaboration.

The introduction of the three phases of the mass event called for the planning of a proportional number of security service briefings and the dislocation of the fixed and mobile posts occupied by them. These activities were carried out in real time at the respective hours:

- 14:00–14:30 – involving 17 members of the security and information services;
- 16:00–16:30 – involving 20 members of the security and information services, bringing the total number of safety personnel to 37;
- 18:00–18:30 – involving 50 members of the security and information services, which resulted in an increase in the total number of safety personnel, eventually reaching 87.

While the implementation of processes aimed at determining the location of posts and estimating the appropriate number of security and information services required detailed calculations, the organisation of medical assistance went much more smoothly. It was determined that in the case of adverse occurrences during the arts and entertainment event, it would be sufficient to provide

two rescue patrols and ambulance teams, among which, in accordance with the Regulation of the Minister of Health of 6th February, 2012, on the basic requirements for medical assistance provision of a mass event, there should be at least one medical doctor. In addition, the Organiser decided to provide a Medical Assistance Point, despite the fact that the referred regulation does not impose this obligation in the case of a mass event with less than 10,000 participants (Regulation of the Minister of Health, 2012, §3, point 3).

Discussion of the results

These measures were carried out with the concept of the integrated safety management of mass events in mind, allowing the results presented in Table 4 to be compiled.

Integrated safety management for mass events is crucial when organising an open-air concert due to several reasons:

1. *Legal and Regulatory Compliance* – organising a concert involves adherence to various legal and regulatory requirements related to safety. Integrated safety management ensures compliance with these regulations, which may include obtaining permits, licences, and certifications, meeting fire safety codes, adhering to building and occupancy limits, and complying with health and safety standards. Failing to comply with these requirements can lead to legal consequences, reputational damage, and, most importantly, it can jeopardise the safety of the attendees.
2. *Crowd Management* – concerts attract large crowds, and ensuring the safety and well-being of attendees is paramount. Integrated safety management involves planning and implementing measures to effectively manage the crowd, including crowd flow, entrance and exit strategies, and emergency evacuation procedures. Given that the efficacy and efficiency of crowd management strategies hinges upon pedestrian conduct, it proves invaluable for stakeholders to possess insights regarding the anticipated, and ideally observed, behaviour of the pedestrian assembly (Gong et al., 2020, p. 192). Consequently, this knowledge holds the potential to offer significant advantages in the realm of crowd management. This helps prevent overcrowding, stampedes, and other potential hazards that can arise from a poorly managed crowd.
3. *Risk Assessment and Mitigation* – concerts involve numerous risks, such as fire hazards, structural collapses, medical emergencies, and even terrorist threats. Integrated safety management requires conducting comprehensive risk assessments to identify potential hazards and implementing appropriate mitigation measures (Silvers & O'Toole, 2020, pp. 20–23). This involves ensuring proper infrastructure, such as sturdy stages, adequate emergency exits, fire suppression systems, and medical facilities, to minimise risks and respond effectively in case of emergencies.
4. *Health and Safety* – organisers have a responsibility to protect the health and safety of concert attendees, staff, and performers. Integrated safety management encompasses measures to address health and safety concerns, including first aid provisions, medical personnel on-site, crowd monitoring for signs of distress, and addressing potential health hazards such as extreme weather conditions or contagious diseases. This promotes a safe environment and minimises the risk of accidents, injuries, or health-related incidents (Memish et al., 2019).
5. *Communication and Coordination* – integrated safety management emphasises effective communication and coordination among all stakeholders involved in the event, including organisers, security personnel, emergency services, and local authorities. Clear communication

Table 4. The results of the implementation of integrated safety management for mass events

Safety	Organiser's tasks	Service	Organiser's tasks	Security	Organiser's tasks
An efficient and effective information policy	• event schedules posted on the premises, • site plan posted at the entrance.	Comfort of the participant of a mass event and concern for his/her well-being	• an adequate number of properly trained information services, • proper medical assurance provision of the performance.	Professional security plan	• a security plan including fixed and shifting security posts, • instructions to be followed in the event of fire or other local threat at the place and time of the mass event.
Modern infrastructure	• event held in a modern stadium, • modern sound and lighting systems.	Professional organisation and logistics of the event	• a facility tailored to the planned number of participants of the event, • designated communication routes, • access to car parks.	Integrated ongoing risk analysis	• ongoing monitoring of the number of participants of the event, • security and information patrols, • dynamic stewarding.
No sector fences or railings	• properly prepared sectors to ensure good visibility and unconstrained mobility around the event area, • properly marked spaces inaccessible to event participants.	Convenient access to the facility enabling the event to take place	• access to the event site by car – parking provided, • location allowing convenient transport by several lines of public transport.	The use of police operational information	• information used to investigate the volume of vehicle traffic showing a direct link to the phases of the mass event, • reporting to the safety manager after the event.
Appropriate signposting of the mass event area	• markings for emergency exits, communication routes, entrance and exit gates, • good signposting and visibility of sanitary, medical and catering facilities.	Professionally prepared parking	• the venue's car park designated only for participants and event organisers, • ongoing traffic management.	Security for all persons present at the event (participants, journalists, etc.).	• security services informed of the different categories of participants taking part in the event, • awareness of possible dangers and how to counter them.
Integrated management and prepared contingency plans	• integrated safety management by ensuring communication between the organiser and representatives of the security and information services, • ongoing exchange of information.	Programmes for participants of the mass event	• event programmes with a paper map accessible to the participants, • detailed schedule of the event available online.	Ongoing surveillance to prevent negative occurrences	• security and information patrols, • alterations of the number of services at individual stations, • responding to undesirable situations.

Table 4 – continued

Safety	Organiser's tasks	Service	Organiser's tasks	Security	Organiser's tasks
Control at entrances	• implementation of security screening according to the gender of the participants, • confiscating items that do not comply with the regulations of the event.	Professional Stewards	• representatives of the security services who are on the list of qualified security personnel, • experienced members of the information services, • safety services trained in dynamic stewarding.	The segregation of participants based on risk analysis	• additional security screening in the case of persons suspected of carrying items breaching the regulations, • no persons under the influence of alcohol or drugs may enter the event area.
Crowdflow management	• information services directing event participants to the appropriate sectors, indicating the nearest exits and communication routes, • professional venue access and exit plans.	Friendly facilities – buffets, sanitary facilities, etc.	• access to food courts offering a varied menu, • listed allergens contained in the each of the dishes, • modern sanitary facilities.	Crisis plans	• prepared plans in the event of a fire or other situation calling for evacuation, • properly marked emergency exits.
The interaction of Police and Stewards with event participants	• the presence of security services among the public, • issuing ongoing messages to prevent undesirable situations.	Entertainment – Accompanying events	• Additional children's play area with inflatable slides, • hair dyeing and braiding activities.	Prevention of terrorist threats	• prepared crisis plan available for security services, police, and fire brigade, • training of security services in counter-terrorism operations.
Emergency medical services	• the provision of two emergency patrols and ambulance teams with a doctor, • the presence of an additional Medical Assistance Point.	Efficient and friendly service	• qualified staff, suitable for working at mass events, • security services patrolling the site during the dismantling of equipment.	Reducing the participation of violent and aggressive persons	• refusing entry to persons who pose a danger to other participants, • ejection from the event area of persons breaking the rules.

Source: Own compilation based on Parszowski & Kruczynski, 2015, p. 17.

channels and well-defined roles and responsibilities ensure a coordinated response in case of emergencies. This facilitates quick decision-making, prompt evacuation if necessary, and overall enhances the effectiveness of the safety management system (Guide on the Security of Major Sporting Events, 2021, pp. 39–41).

In summary, integrated safety management for mass events such as an open-air concert is essential to ensure the well-being of attendees, mitigate risks, respond effectively to emergencies, and comply with legal and regulatory obligations. It helps create a safe and enjoyable environment for everyone involved while minimising potential hazards and ensuring a successful event.

Conclusions

General summary

The concept of integrated safety management for mass events implemented by cultural centre in the Świętokrzyskie voivodeship, based on the ongoing exchange of information between the security services and the event organiser, led to the minimisation of the risk of adverse events. Public order authorities remained fully aware of their role in the incident prevention process, responding quickly and effectively to any threats.

The estimated number of security and information services present at individual stations fully complied with the existing requirements, not infringing the principles stemming from the act on safety of mass events. In addition, medical assurance carried out by mobile rescue patrols, supplemented by an additional Medical Aid Station, led to the appropriate preparation of the area covered by the mass event in case of emergency.

Therefore, the presented activities enable a positive verification of the hypothesis, proving that the concept of the integrated safety management of mass arts and entertainment events implemented by the organiser, based on the idea of dynamic stewarding, had been developed in a way that ensured an appropriate level of event participant safety.

Recommendations for practice

Based on the experience of one of the Świętokrzyskie cultural centres regarding the integrated security management of artistic and entertainment events, the following recommendations for mass event organisers were developed:

1. *Conduct a comprehensive risk assessment* – before organising the event, perform a thorough risk assessment to identify potential security threats and vulnerabilities. Assess the venue, crowd capacity, access points, infrastructure, and external factors that could impact security (Koski et al., 2020). This assessment will serve as the basis for developing a robust security plan.
2. *Develop a security plan* – create a detailed security plan that encompasses all aspects of the event. This plan should include measures for crowd management, access control, perimeter security, emergency response, communication protocols, and collaboration with local law enforcement and emergency services. Make sure that the plan is tailored to the specific event and takes into account the identified risks.
3. *Collaborate with relevant stakeholders* – establish strong relationships and effective communication channels with all relevant stakeholders, including local law enforcement, emergency services, venue management, event staff, and security personnel. Foster collaboration and

make sure that everyone is aware of their roles and responsibilities in maintaining security during the event.

4. *Implement access control measures* – implement robust access control measures to prevent unauthorised entry and maintain crowd safety. This may include ticketing systems, ID checks, bag searches, metal detectors, and security personnel stationed at entry points. Clearly communicate entry requirements to attendees in advance to streamline the process and minimise delays.
5. *Deploy visible security presence* – ensure a visible security presence throughout the event venue. This includes uniformed security personnel, surveillance cameras, and signage indicating security measures in place. Visible security measures act as a deterrent and help reassure attendees that their safety is a priority.
6. *Monitor and manage the crowd* – continuously monitor crowd behaviour and flow throughout the event. Use trained personnel to identify potential issues such as overcrowding, aggressive behaviour, or signs of distress. Implement crowd management strategies to prevent bottlenecks, maintain orderly movement, and address any emerging safety concerns promptly.
7. *Provide emergency preparedness and response* – develop and communicate clear emergency protocols to all event staff and attendees. Establish procedures for evacuations, medical emergencies, and response to potential threats. Conduct drills and train staff on emergency response to ensure preparedness. Maintain close communication with local authorities and emergency services for swift coordination if needed.
8. *Conduct post-event evaluations* – after the event, conduct a thorough evaluation of the security measures and response. Identify any shortcomings or areas for improvement and implement necessary changes for future events. Collect feedback from attendees, staff, and relevant stakeholders to gain insights and enhance security practices.

However, each mass event has a unique character. Therefore, the presented recommendations should be appropriately adapted to the environmental conditions, enabling the highest possible level of safety for participants.

Research limitations and suggestions for future directions

Further research on the integrated management of safety at mass artistic-entertainment events may encounter certain limitations. One of the key constraints is data availability. Therefore, further research should focus on collecting and analysing data not only from event organiser documents, but also from police and medical reports. Such data can provide valuable information for future research.

Another limitation is the complexity of the system itself. The integrated management of safety at mass arts and entertainment events involves various entities and agencies working together. Understanding the interactions between these entities and finding ways to improve communication and coordination among them is crucial. Future research should thus delve into this aspect, exploring effective strategies for collaboration and communication within the complex system.

Furthermore, research should assess the effectiveness of different actions undertaken within the framework of integrated safety management. By evaluating the impact of specific actions on enhancing safety and responding to crisis situations, valuable insights can be gained. This evaluation can inform future practices and help identify areas for improvement.

Lastly, considering the international nature of these events, research should incorporate aspects of international collaboration and information exchange in safety management. Mass artistic-entertainment events often attract participants and artists from different countries, necessitating coordination and cooperation at the international level. Exploring effective models of international collaboration in safety management can greatly contribute to the overall success of these events.

In conclusion, systematic extension of scientific research with the described directions may enable the creation of a comprehensive safety management system for mass artistic and entertainment events, increasing the level of safety of all entities participating in a given project.

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Interpretation Problems of the Legal Norms of Municipal Companies in Poland

Abstract

Objective: The article addresses the problem related to the interpretation of legal norms on the functioning of municipal companies, filling the research gap resulting from the paucity of literature and scientific research on the interpretative difficulties as well as the lack of clear-cut solutions on this issue. The problems that have arisen in connection with the free interpretation of legal norms on the functioning of municipal companies indicate the necessity of isolating a legal definition of a municipal company in the legal system and defining separate and unified legal norms for this entity. This would often avoid contradictory interpretations of the law or interpretation of the law according to the principle of "good practice". The objective is to indicate the need to create a dedicated legal standard(s) for municipal companies (particularly with a majority share of local government units).

Research Design & Methods: In the course of the research process, various methods were used, including analysis of the literature review, the method of analysis, synthesis, and deduction, as well as legal acts and data on the activities of selected municipal companies.

Findings: The lack of a uniform (sanctioned by detailed, systemic legal regulations) model of a municipal company translates into numerous interpretation problems in applying legal acts dedicated to this legal form. This results in ineffective corporate governance and numerous irregularities in the functioning and exercise of control by local governments, courts, and provincial offices (supervision by the Governor) over companies with local government participation.

Implications/Recommendations: The guidelines about municipal companies should delineate the issues currently addressed across various legislative enactments, incorporating oversight and regulation of utilising public funds. Moreover, this shall contribute to ensuring the judicious conduct of financial operations in conformity with legal standards.

Contribution/Value Added: The suggested definition sets out clear criteria for identifying entities with hybrid public and private management characteristics involved in public utility tasks. Additionally, the proposal emphasises considering social and economic factors, using specialised indicators to assess municipal company performance, and underscores the need to articulate their roles precisely within legal frameworks and in fulfilling socioeconomic missions.

Keywords: interpretation of legal norms, municipal companies, management of municipal companies, local government, supervision, control, audit

Article classification: theoretical article, conceptual article

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Introduction

The issue of defining a company owned by local government units and locating it in the legal system has been raised for years (Gonet, 2007). Considerations as to which category of entities it should be included in are still ongoing. Every attempt to define or specify the law in this respect ends with the appearance of further doubts or interpretation problems. In the Polish legal system, there is no unambiguous, universally accepted definition of a municipal company (Srokosz & Raczek, 2022; Biliński et al., 2020; Klimek, 2017; Byjoch & Klimek, 2015). As Z. Dolewka notes, the term is used by academics, practitioners of local government life, representatives of social and civic organisations, mass media, and politicians. This split makes it difficult to accurately understand the content of a municipal enterprise, referred to as a municipal company (Dolewka, 2022).

Despite the difficulties of interpretation and the lack of clear-cut solutions to this issue, we identify a paucity of literature and research on municipal companies. The identified research gap provided the rationale for undertaking the research and allowed us to identify the main research question: Is there a need for a dedicated legal standard(s) for a municipal company in the light of the existing interpretative problems? The consequence of this is the adoption of the research objective as an indication of the necessity of establishing separate from other, unified legal norms for municipal companies (in particular with a majority shareholding of local government units).

The realisation of the research objective was based on the hypothesis that the lack of a statutory definition of a municipal company causes doubts and problems in the application of the regulations concerning such companies, and may prolong the decision-making process and increase costs associated with the need to obtain further legal opinions, interpretations or private investor tests. Underlying the hypothesis formulated in this way were the results of previous research on the characteristics of municipal companies operating in local government.

The first part of the article discusses the concept of a municipal company as one of the forms of performing public utility tasks by local government units, while the following part focuses on analysing the interpretation of the existing legal norms and presenting the problems arising from the lack of unified regulations governing the activities of these companies, proposing solutions to improve the functioning of this area.

Research methodology

In order to assess the analysis of the problems of interpreting the legal norms dedicated to municipal companies, various methods were used during the research process, including the analysis of continuous publications, the literature review methodology, the method of analysis, synthesis, deduction, as well as the analysis of existing data (in particular, management reports and financial statements of municipal companies and documents produced for the purposes of corporate governance of companies with the participation of the analysed municipality), the application of which is necessary, as it enables the understanding of the studied problem.

Literature review and theory development

The characteristics of municipal companies

Municipal companies are often defined as companies set up by municipalities or other local authorities to carry out specific public tasks. However, this definition is not included in any legal

provision. The main feature of these entities is to carry out activities in the area of public utility. The final model for the provision of municipal services, in particular the implementation of these tasks through companies with local government participation, was shaped in the 1990s. "At that time, the concept of the so-called 'free market' and the principle of non-interference of the state in the economic sphere prevailed" (Klimek, 2017).

Pursuant to art. 9 pt. 4 of the Act of 8th March, 1990, on Municipal Self-Government (Act on Municipal Self-Government, 1990; Journal of Laws of 2023, item 40), public utility tasks are the commune's own tasks whose aim is to satisfy the collective needs of the population on an ongoing and uninterrupted basis through the provision of generally available services. On the other hand, in Article 1 of the Act of 20th December, 1996, on municipal management (Municipal Management Act, 1996; Journal of Laws, 2021, item 679) sets out the principles and forms of municipal management of local government units, which are to consist in the performance by these units of their own tasks in order to satisfy the needs of the local community. At the same time, as emphasised by M. Biliński and his team, municipal economy has to find a balance between providing accessible and high quality public services and maintaining their profitability and efficiency, regardless of the management model. This is particularly difficult when the market interests of external actors collide with the needs of the local community (Bilinski et al., 2020).

It should be noted that commercial companies are listed as forms of carrying out this activity. As entities with legal personality, municipal companies function in the Polish legal system on the basis of the Commercial Companies Code (Commercial Companies Code, 2020). Due to the lack of dedicated solutions for this type of company, by virtue of this legal act, in principle, such a company is treated like any entity operating in this organisational form on the open (unregulated) market.

This general qualification puts them on an equal footing with other companies, both those that cater to the needs of residents and businesses (e.g. water, sewage, waste, transport, municipal construction, and heat) and those that operate in a competitive commercial market and provide services or products produced by various economic operators. They are considered to be borderline companies (Jacyszyn, 2008), combining a social purpose and an economic purpose. The assessment of their activities and condition is based on economic and financial indicators typical of the commercial market. They have to satisfy the basic needs of the population, carry out continuity of services, and at the same time take care of the optimal level of profit and compete in the market, while, for example, complying with the law in terms of not only public procurement, but also, as pointed out by M. Biliński et al., public-private partnership and concessions for works or services (contracting, public entity) (Bilinski et al., 2020).

The combination of economic and social objectives in economic activity, as D. Klimek (2017) emphasises, is one of the difficult problems that arise both in science and in practice. This problem is particularly evident where the state has to regulate the availability of services, because it is unable to perform its duties fully due to financial or staffing constraints. When the state has to choose between social objectives and hard market rules, it creates legal and organisational solutions to combine the two. This is precisely the situation in the municipal services sector.

According to many researchers, the specific characteristics of municipal companies (such as, e.g., monopolistic market position, non-market pricing, low price elasticity, territorial limitation of activities, high capital intensity of assets, strong social and political impact of the environment on the company, strong economic and social impact of the company on the environment) should be a sufficient reason to create separate legislation (Byjoch & Klimek, 2015). This is due, among

other things, to the fact that the practical aspect of the existing legal norms often deviates from their original purpose of application in the context of municipal companies.

The concept of a municipal company as a form of business in local authorities

There is no definition of a municipal company in the Polish legal system. The Municipal Management Act uses the phrases 'commercial law company', 'company with the participation of local government units' (Bilinski et al., 2020). On the other hand, in the literature, the term is most often applied to a one-person company or a company with a majority share of a local government unit. According to the legislation, local government units are entitled to create various organisational forms in order to carry out municipal activities. These can be classified in various ways: from those forms under public law management (budgetary establishments, budgetary units, local government cultural institutions) to those under private law management (municipal companies, cooperatives) (Bilinski et al., 2020) or may form commercial law companies, whereas commercial companies are general partnerships, partnerships, limited partnerships, limited joint-stock partnerships, limited liability companies and joint-stock companies (NASA Judgment, 2000).

The choice of the specific organisational form of municipal activities is within the competence of local government bodies (Act on Municipal Economy, 1996; Journal of Laws, 2021, item 679), should be adequate to the scale of the tasks performed, being derived from the needs of local communities, and depends on the classification of a given type of activity of the local self-government unit to the sphere of public utility (Biliński et al., 2020). Moreover, the principle of rational management and spending of public funds should also be applied in each area of activity of the local government, including the forms and manner of conducting municipal management (Bilinski et al., 2020).

Researcher K. Żuk (2006) distinguishes two basic groups. The first one is communal public property comprising that part of property which serves the direct satisfaction of public needs of local communities and remains under the direct management of local authorities (budget units and establishments). The criterion for assessing these municipal organisational units should be primarily related to the degree of satisfaction of social needs. The second type, on the other hand, are entities adopting the form of single-person municipal companies or companies with a majority shareholding, operating in various spheres of economic activity and conducting profit-oriented activities (Dolewka, 2017).

Further analysis of the literature on the subject makes it possible to distinguish three main strands relating to the concept of a municipal company. The first one perceives the municipal company in a narrow sense and limits it only to companies in which 100% of the shares belong to an entity or local government units (Supervision in Municipal Commercial Companies, 2008). Such an interpretation is also adopted by the Supreme Court, stating that only if a municipality took up the entire share capital should a joint-stock company be considered a separate municipal legal person, and stressed that such an interpretation of the concept of a municipal legal person is in line with the view expressed in the resolution of 10th January, 1992, III CZP 140/91 (Stahl, 2002). The second strand assumes that the exercise of actual voting control, i.e. the possession of a majority shareholding, is sufficient to define a municipal company. In contrast, the last category takes into account the broad concept of a municipal company. According to this current, any incorporated company in which a local authority is involved should be considered a municipal company. The consequence of such a determination is the assumption that we are dealing with a municipal

company regardless of the number or size of shares held by the local government (Supervision in Municipal Commercial Companies, 2008).

Having regard to the fact that the basic tasks of the local self-government unit include the performance of services of general interest, the purpose of which is the current and uninterrupted satisfaction of the collective needs of the population through the provision of generally available services (Act on Municipal Self-Government, 1990; Journal of Laws, 2023, item 40), it may be added that a municipal company is a company with the participation of a local government unit performing public utility tasks. The range of tasks is diverse and includes, among others, water supply and wastewater management, public transport management, the maintenance of roads and road infrastructure, health services, housing services. Municipal companies may also undertake other tasks depending on local needs and the specifics of the local government concerned.

As Srokosz and Raczek (2022) rightly note, municipal companies cover a wide range of activities, from municipal services, to municipal infrastructure, to enterprises of a manufacturing or service nature. Their activities are often diverse and multifaceted, which makes their scope of operation ambiguous. Furthermore, combining entrepreneurial aspects with public functions results in specific challenges both in terms of legislation and practical management.

According to the definition of M. Szydło, "a municipal company is a separate legal institution. A legal institution, being a peculiar analytical concept or concept-tool of the theory of law and detailed legal sciences, can be distinguished or defined in the following three approaches: normative-complex, functional (action) and personal. In the normative-complex view, a legal institution is a distinct and functionally forming whole complex (set) of rules (norms) regulating a specific social relationship. In functional (action) terms, a legal institution is a set of actions determined by the above-mentioned complex of rules (norms). Finally, in personal terms, a legal institution is a person or a set of persons acting on the basis of the aforementioned complex of rules (norms). A municipal corporation is a legal institution in all three approaches distinguished above. In particular, a municipal company is a legal institution in the normative-complex view. As such, it is a separate and functionally forming whole (unity) complex of provisions (norms) normalise a specific social relationship, specifically normalise the social relationship of a municipal company" (Szydło, 2016).

The researcher also points out that the special nature of a municipal company directly affects entities legally or functionally related to it. According to the author, different actors, such as the legislator, the courts, the controlling bodies, the local government units, and the persons acting in municipal companies all may have different approaches to the enactment and application of the law on municipal companies. Each of these actors may set different objectives in their legislation, which may differ in content or nature, even though they relate to the same legal area (Szydło, 2016).

In particular, while the constituting or executive bodies of local government units are inclined to interpret or concretise the aforementioned legislator-designated general objective in a broader and more liberal manner, administrative courts, provincial governors, regional chambers of audit and the Supreme Audit Office tend to interpret or concretise this legislator-designated general objective in a narrower and restrictive manner (Szydło, 2016). This highlights the complexity and diversity of interpretation and application of the law in the context of municipal companies.

An example illustrating the problem at hand is the Judgment of the Provincial Administrative Court, 2016, concerning a resolution of the Lubomia Municipal Council, which introduced the "Lubomia 3+ Family Card" for families with many children. In this case, the Municipal Council interpreted the provisions of the Municipal Self-Government Act in an expansive manner

to introduce additional benefits for families with many children in the municipality. A number of other examples are presented in the report (Implementation of Public Tasks by Companies Established by Local Government Units, 2014).

Also T. Srokosz and K. Raczek (2022) draw attention to the diversity in the jurisprudence of common courts, administrative courts, as well as the National Appeal Chamber (NAC) concerning municipal companies. According to the researchers, contradictions in the rulings may result from differences in the interpretation of the law, which translates into ambiguity in the application of the law with regard to municipal companies (Srokosz & Raczek, 2022).

A significant effect of such uncertainty in the free interpretation of legal provisions relating to local authority companies is to introduce legal uncertainty on the part of executive bodies. Legal uncertainty in the context of municipal companies refers to a state of affairs in which the executive bodies of local government units are faced with the challenge of interpreting and applying legal provisions in a way that is not always clear or unambiguous. It results from the lack of consistent and precise legal regulations on the activities of municipal companies. This results in difficulties in decision-making and the risk of taking actions that are unlawful or ineffective in terms of the company's objectives and the public interest.

This also results in other consequences, ranging from the abandonment of activities (e.g. investments) due to legal uncertainty and related potential liability consequences, to financial consequences related, e.g. to penalties imposed by external control bodies. Political risk is also important – failure to invest or otherwise act, paying penalties from the municipal budget (vide: residents), may result in an unfavourable perception in the eyes of potential voters.

Specific legal regulations for companies with local authority participation and the resulting selected interpretation problems

The basic regulatory principles of Polish legislation on municipal companies include: Act on Municipal Economy, 1996; Journal of Laws, 2021, item 679; Act on Municipal Self-Government, 1990; Journal of Laws of 2023, item 40; Act on County Self-Government, 1998; Journal of Laws of 2022, item 528; Act on Provincial Self-Government, 1998; OJ 2022, item 547. At the same time, as noted by M. Biliński, W. Gonet and H. Wolska, the Act on Municipal Management constitutes only a minor part of the regulations on municipal management. At the same time, it is a rather general act to which a number of solutions included in other legal acts are referred to (Biliński et al., 2020). Within the framework of legal regulations concerning municipal companies, it is necessary to take into account the provisions of commercial law and other specific legal acts directly affecting the activities of these companies. We can point to the following normative acts: Act on Restriction of the Conduct of Business Activities by Persons Performing Public Functions, 1997; Law of 2023, item 1090; Regulation of the Minister of the Treasury on the Determination of the Model Statement on the Acceptance of the Obligation to Shape the Remuneration of Members of the Governing Body in the Company, 2016a; Journal of Laws 2016 item 1461; Act on Disclosure of Information on Documents of the State Security Authorities from 1944–1990 and the Content of Such Documents, 2006; Journal of Laws 2023 item 342; Act on Public-Private Partnership, 2008; Journal of Laws of 2023, item 1637; Act on Responsibility for Infringement of Public Financial Discipline, 2004; Journal of Laws of 2023, item 1030.

Unfortunately, this diversity gives rise to a number of legislative and interpretative problems faced by the ownership bodies (local government units) during day-to-day cooperation, in particular

at the level of joint investments, delegation of tasks, or control over the companies in question (Financing and Supporting the Activity of Companies with the Share of JST in the Lower Silesian voivodeship, 2021; Implementation of Public Tasks by Companies Established by Territorial Self-Government Units, 2014).

One of the main problems is the lack of a definition of a municipal company in the Municipal Management Act and the varying criteria for its separation and definition (Municipal Economy Act, 1996; Journal of Laws, 2021, item 679). This results in the interchangeable use of the terms: municipal company, local government company, company under the control of local government, or company with the participation of local government units. There is no doubt that a company in which the sole shareholder is a local government unit is a municipal company and a municipal legal person at the same time (Szczepaniak, 2010). Doubts arise when dealing with mixed capital, i.e. public-private, when the local government co-owns shares with a private entity. The legislator, for the purposes of the law of municipal economy understood as a complex branch of law, which is characterised by the use of various methods of regulation – administrative, civil, and even criminal – while refraining from defining the concept of a municipal company, proposed a division of municipal companies into companies operating in the sphere of public utility and companies operating outside this sphere (Wronkowska, 2005). A detailed analysis of this problem was conducted by K. Byjoch (2017).

In turn, Act on Municipal Self-Government, 1990; Journal of Laws, 2023, item 40, defines the organisational units that may be established by a municipality, determines the competence to conduct economic activity, and lists the forms of carrying out tasks of a public utility nature. Although, as indicated by R. Płaszowska (2016), public utility tasks belong to the self-government's own tasks, not all own tasks are public utility tasks. They should be interpreted as broadly as possible (Resolution of the Constitutional Tribunal on Determining the Commonly Applicable Interpretation of the Public Procurement Act, 1997) and should not be equated with 'ordinary' services. As M. Sadowy (2010) notes, the basic feature of activities in the sphere of public utility is the daily, absolute, and reliable satisfaction of the needs of the population and economic entities. Furthermore, these services must be provided even when there is insufficient prosperity in the market and must be provided continuously and reliably. As a rule, needs such as food, clothing, and housing are mostly fulfilled by a competitive market. However, if – in accordance with EU law – public authorities consider that certain services are in the general interest and the free market cannot provide them comprehensively and sufficiently, they may establish a number of special rules for the provision of these services. These entities may be granted special powers or provided with specific funding mechanisms (Services of General Interest in Europe, 2001; European Council Meeting 1993–2002, 2000).

In addition, the lack of a legal definition of public utilities can constrain the development of local infrastructure and services, lead to conflicts and inefficient use of resources, make it difficult to obtain state funding and support for public utility projects, as well as create misunderstandings and conflicts.

Another major problem is the legislation governing the following issues:

- the mandatory appointment of the supervisory board;
- the term of office of the supervisory board;
- competencies and requirements for candidates for supervisory board members and members of the management board (introduced in Law on the Principles of State Property Management, 2016; Journal of Laws 2016, item 2259);

– restrictions on the possibility of combining the functions of a member of the supervisory board in more than one company with local authority participation;
– making contributions and taking up shares in companies;
– the disposal of shares in companies;
– the definition of public service regulations;
– the transformation of municipal enterprises.

It is worth noting that the institution of the management board in municipal companies applies only to capital companies, where, in accordance with the provisions of the Commercial Companies Code, they have a body, namely the management board. The institution of the board of directors is only applicable to limited liability companies and joint stock companies established by a local authority, as this body does not function in partnerships (Biliński et al., 2020). The legal regulations are covered by the provisions of the Commercial Companies Code and the Municipal Management Act. In accordance with Article 10a(6) and (7) of the Municipal Economy Act, 1996; Journal of Laws, 2021, item 679, the supervisory board appoints the members of the management board of municipal joint-stock companies and limited liability companies. This provision is *lex specialis* with respect to the provisions of the Commercial Companies Code, according to which a member of the management board in a limited liability company is appointed and dismissed by a resolution of the shareholders, unless the articles of association provide otherwise. Management board members in joint stock companies, on the other hand, are appointed and removed by the supervisory board, unless the company's articles of association provide otherwise. In local government limited companies, the process of the appointment of board members by the supervisory board, although formally appearing 'independent' of the will of the owner, in practice may be shaped by the owner. The members of the supervisory board are appointed by the owner and the manner of voting on resolutions to appoint or dismiss the management board is set out in the company's articles of association or the management board's bylaws, amendments to which are at the discretion of the shareholders' meeting or, in the case of single-member companies, the mayor or president.

The same is true for the statutory three-year term of office of the supervisory board. Municipal Utilities Act, 1996; Journal of Laws 2021, item 679, introduced a three-year term of office for a member of the supervisory board in companies with a majority shareholding of local government units. It is not allowed to change this period under the provisions of the company's contract or articles of association. The function of such provisions was to ensure the independence of supervisory board members from changing political conditions and to limit the possibility of pressures that might occur if the board's term of office were determined on a case-by-case basis by the founding body or the general meeting of shareholders. However, according to the Commercial Companies Code, a supervisory board member can be dismissed by a decision of the shareholders' meeting at any time. This provision unequivocally refutes the idea of a three-year unbreakable term of office.

Another piece of legislation detailing the provisions on municipal companies is the Act on Restriction of Business Activities by Persons Performing Certain Public Functions (Act on Restriction of Conduct of Business Activities by Persons Performing Public Functions, 1997; Journal of Laws 2023, item 1090). It defines restrictions on the conduct of business activities by persons holding managerial positions, within the meaning of the provisions of the Act on Remuneration of Persons Holding Public Functions and the Act on Principles of Remuneration of Persons Managing Certain Companies (Act on Principles of Remuneration of Persons Managing Certain Companies, 2016; Journal of Laws 2016 item 1202).

This Act regulates in detail the possibilities and limitations in shaping the remuneration of persons managing companies with the participation of local self-government units, the State Treasury, and state legal persons, as well as issues in the scope of selected provisions of contracts concluded with managing persons. Moreover, it defines the position of these bodies in the structures of companies with participation of local self-government units in a manner quite different from the previously applicable legal norms. The amendments introduced in 2016 (Act on the Principles of Shaping the Remuneration of Persons Managing Certain Companies, 2016; Journal of Laws 2016, item 1202) exempted company boards from the jurisdiction of the Labour Code. An absolute obligation to conclude civil law contracts with company boards was introduced and the criteria for awarding additional remuneration were specified. The manager became a manager, so to speak. The amount of remuneration for managers was made dependent on the value of selected economic and financial parameters. Thus, the ownership (or supervisory) body was deprived of the possibility to shape the remuneration of managers in a manner established by internal regulations. A requirement was introduced to assess the performance of management boards based on predetermined (measurable) management objectives. Such evaluation, without the possibility to indicate additional justification, is often impossible to establish reliably/according to reality, unfair or completely detached from reality. On the one hand, the setting of variable remuneration based on predetermined criteria (management objectives) and the weights assigned to them is devoid of subjectivity, while on the other hand – contrary to the legislator's expectations – it may lead to a lack of commitment on the part of managers to the development of the company in many areas by focusing on the implementation of a specific (often single) task.

The contradiction of the assumptions of the above-mentioned act results from the fact that, assuming a typically managerial approach to the management of companies, which, as we emphasised above, fulfil social goals in addition to economic ones, and their activity often depends not on the rationalisation of the economic assumptions of the company's operation, but on the will of the owner, the legislator ordered that the goals on the basis of which the manager would be assessed should be predetermined and measurable. When attempting to relate these principles to the tasks of municipal companies, the purpose of which is the continuous and uninterrupted provision of services of general interest, the indication of such a purpose may be considered unmeasurable.

On the other hand, attempts at a typically 'economic' approach, based on the profit and loss account and referring to two variables – revenue and costs – are also questionable. A company operating under 'ordinary' goods conditions such as production or trade will always seek (as a rule) to increase revenues while reducing operating costs.

In a public service environment, setting a cost reduction target of a certain value (so that it is measurable), without the possibility of introducing so-called additional information into the assessment, may, in fact, lead to a lack of the implementation of renovation intentions or an ineffective employment policy. Attempting to compensate for these actions with an increase in revenue is also fraught with risk. An increase in revenue necessitates an increase in utility prices. In addition, prices for municipal services are often set by external bodies (city council, regulators), over which company boards have largely no influence. Of course, there are many other measurable economic indicators, widely described in the literature, which are the basis for management evaluation, but the way in which they are applied – for a municipal company – may also be questionable (the problems of economic indicators will be discussed in the following sections).

Considerations of the complexity of the problem and the contradictions between the public utility of municipal entities, working for the quality of life of the inhabitants and improving the operating conditions for local entrepreneurs, and the economic rules of the market economy, mean that the issues of public utility and relating them to social as well as economic objectives have not been clearly resolved (Klimek, 2017).

In turn, the law on the principles of state property management (Act on Principles of Management of State Property, 2016; Journal of Laws 2016, item 2259) – directly implemented to local government companies the solutions adopted for companies with State Treasury shareholding – in terms of requirements for members of management and supervisory bodies and in terms of rules for the disposal of shares and stakes. These provisions raise many doubts from the perspective of companies with majority private capital participation. In such a case, even when the local government's shareholding is negligible and the majority shareholder of the company is an entrepreneur from outside the public sector, the owner has to meet the conditions for establishing and applying the provisions on the competence of the management and control body. It is significant that according to the Act on the Principles of Shaping the Remuneration of Persons Managing Certain Companies, 2016; Dz.U. 2016 item 1202, and the regulation of the Minister of the Treasury (Regulation of the Minister of the Treasury on the Determination of the Model Statement on the Acceptance of the Obligation to Shape the Remuneration of Members of the Management Body in the Company, 2016a), a candidate for a member of the supervisory body shall submit a declaration of acceptance of the obligation to shape in the company the remuneration of the members of the management body in accordance with the discussed Act.

In practice, the implementation of this obligation may be limited in situations where the local authority holds a minority shareholding. In such a case, despite the formal obligation, the local government as a minority shareholder may not have sufficient influence over the decisions of the supervisory body, especially when it comes to the remuneration of the board, due to its limited ability to vote down proposals that differ from those proposed by the majority shareholders. This means that the submission of a declaration by a supervisory body candidate does not always translate into a real possibility to influence the company's remuneration policy, especially when the local government's shareholding is minority and does not ensure a controlling vote on the supervisory body. Although the Act on the Principles of Shaping the Remuneration of Persons Managing Certain Companies, 2016; OJ 2016, item 1202, imposes a formal obligation, the effectiveness of its implementation depends on the specific ownership structure and voting powers in the company concerned. This also points to the complex dynamic between the formal statutory requirements and the practical aspects of managing companies in which the local government does not have a decisive vote.

Moreover, it opens the way for disputes that may arise against this background between the majority private owner (who takes care of his/her property) and the representative of the public shareholding (who wants to implement the provisions of the Act). The implementation of this obligation is introduced by Article 2(2) para. 1 (Act on the Principles of Shaping the Remuneration of Persons Managing Certain Companies, 2016; Journal of Laws 2016, item 1202), ordering the entity entitled to exercise shareholder rights "to cause the general meeting of the company to vote on draft resolutions on the principles for shaping the remuneration of members of the management body and members of the supervisory body of the company in accordance with the Act and to cast votes in favour of their adoption". According to the provisions of the Commercial Companies Code, only in the case of a minority shareholder holding more than 1/10 of the share capital,

a shareholder representing at least 1/10 of the share capital has the right to convene an extraordinary shareholders' meeting and place matters on the agenda (Art. 236 § 1; Commercial Companies Code Act, 2020; Act of the Code of Commercial Companies, 2020, item 1526 as amended) or a shareholder representing at least 1/20 of the share capital may request that certain matters be placed on the agenda of the next shareholders' meeting (Act of the Code of Commercial Companies, 2020; Journal of Laws 2020, item 1526, as amended). Thus, the legislator leaves unanswered the question of what legal means a member of the controlling body has that can be used to fulfil this task.

The Court of Appeal in Białystok confirmed that from the essence of a capital company, including a limited liability company, stems the principle of the rule of the majority over the minority, expressed, inter alia, in the provisions of Article 245 and Article 246 of the Code of Commercial Companies, this principle is related to the principle of proportionality of rights and contributions, which means that if a shareholder has made a larger contribution to the company, he should also have more rights in the company (more votes at the company's meeting) than a shareholder who has made a smaller contribution. Consequently, in relation to capital companies, there is talk of the primacy of capital over the person (Ruling details I AGa 27/18, 2018).

The Law on Responsibility for Breach of Public Finance Discipline also applies to laws affecting the operation of municipal companies (Act on Liability for Breach of Public Finance Discipline, 2004; Journal of Laws of 2023, item 1030; Journal of Laws of 2023, item 1030) to the extent referred to in Section II, Chapter 1, concerning responsibility for violation of public finance discipline. Importantly, neither municipal companies nor their employees are subject to liability for breach of public finance discipline. Exceptions in this respect are set out in Article 4.2 and Article 4a of the Act on Liability for Breach of Public Finance Discipline. However, these exceptions also apply to employees of any entity which is not a unit of the public finance sector. Moreover, there are the provisions of Chapters XXXIII–XXXVII of the Penal Code, 1997; Journal of Laws, 2023, item 289 – regarding offences against protection of information, offences against credibility of documents, offences against property, as well as offences against economic turnover and property interests in civil law transactions and against trading in money and securities. Detailed guidelines on the conduct of competitive activities by members of company bodies and sanctions for violations of competition rules are provided for in the Competition and Consumer Protection Act (Competition and Consumer Protection Act, 2007; Journal of Laws 2023, item 1689).

Thus, the above selected contradictions in the legal norms have a practical impact on the operation of companies with local government participation and raise a number of legal, economic as well as managerial problems.

As emphasised by researchers T. Srokosz and K. Raczek (2022), corporate governance in municipal companies is of a unique nature, as the owners of these companies are local government units (municipalities, counties, or provincial governments). These units have a dual role: they are both entrepreneurial legal entities and public authorities. The head of the municipality, mayor or town mayor, exercising both administrative and ownership functions, influences the municipal services market by issuing administrative decisions and participating in the general meetings of municipal companies. This means that decisions regarding municipal companies are often linked to both entrepreneurial goals and the needs of the local community (Srokosz & Raczek, 2022).

Discussion

In summary, it can be pointed out that the provisions concerning the municipal company should detail the issues currently contained in a number of acts, such as, *inter alia*:

- state aid, or the lack thereof, in the event of a cash recapitalisation of the company or an in-kind contribution (in exchange for shares subscribed);
- the definition of specific financial and non-financial indicators dedicated to the analysis of the company's financial and asset situation in the short and long term, taking into account investments in progress or investment needs and the sector-specific nature of the municipal company;
- clarifying the reporting of depreciation and amortisation in the financial analysis – especially in cases where the value of operating costs is the basis for setting tariffs/fees to be paid by residents;
- creating a uniform and rational way of remunerating company managers (combining the need for high qualifications with achievable remuneration, allowing for additional variable remuneration in case of social, missionary goals – *vide*: often immeasurable);
- the clarification of the provisions allowing or indicating the conditions for companies to carry out activities outside the sphere of public utility;
- the clarification of the possibility of joining (or forming) companies outside the home territory of the municipality;
- the removal of mutually exclusive or inconsistent provisions arising from different pieces of legislation (e.g. pursuant to Article 10a(3) of the Municipal Utilities Act, 1996; Journal of Laws, 2021, item 679), in companies with a majority shareholding of the municipality, the term of office of the supervisory board is three years, whereas according to the Commercial Companies Code Act, 2020, "by a shareholders' resolution, members of the supervisory board may be dismissed at any time";
- the clarification of the provisions of Article 10 (1)-(3) (Municipal Utilities Act, 1996; Journal of Laws, 2021, item 679) so that they do not contain "vague" terms ("unmet needs", "to a significant extent", "important for the development of the municipality", etc.) This leaves a large margin allowing for free interpretation of these provisions. This is not always done in a restrictive manner. The essential premise should be to demonstrate the relationship of Article 10(1)-(3) (Municipal Utilities Act, 1996; Journal of Laws, 2021, item 679) with article 6 and article 7 of the (Act on Municipal Self-Government, 1990; Journal of Laws of 2023, item 40);
- clarifying or extending the applicability of the 'in-house entity' provisions beyond the realm of public procurement;
- the clarification of the legal liability of board members;
- the introduction of more stringent criteria for assessing investment performance;
- establishing clear, understandable, and accessible rules and procedures to ensure fairness, accountability and transparency in financial management. This will enable the monitoring and control of how public funds are used. Furthermore, it will help to make sure that financial activities are carried out in an accountable and legal manner. In addition, the formulation of rules is key to building public trust and ensuring effective public financial management.

The above indications are not an exhaustive catalogue of all improvements and changes that can be made to the regulation of municipal companies. In addition, it should be emphasised

that any change should be carefully considered in order to ensure consistency in legislation and efficiency in the management of municipal companies.

Implementing a public service mission effectively and in accordance with the principles of the law requires the creation of a legal basis that is the core of all activities serving the local community, among other things with care for public funds.

The problems of the interpretation of the legal norms dedicated to municipal companies, demonstrated in the article, lead to a number of anomalies that may result, among other things, in difficulties in decision-making and the implementation of business activities, which may lead to delays in developing and achieving business objectives, as well as waste of funds that could serve residents, or the abandonment of investment plans. In addition, legal instability can lead to a lack of confidence on the part of investors and customers, and, consequently, a reduction in the availability of financing. Also, an increase in legal risk can result in costly litigation and financial losses.

As a confirmation of the necessity of the legal provisions established and adopted by the legislator, it is worth citing, in fine, M. Szydło (Municipal Management Act. Commentary, 2008), who defines the principle of legalism in relation to tasks performed by public authorities as acting on the basis of a specific, literal legal norm, excluding the so-called general exclusionary norm, according to which if a given behaviour is neither prohibited nor ordered by the legislator, then this behaviour is legally indifferent from the point of view of the legal order. The researcher emphasises that the concept of a general norm, in relation to the activities carried out by public authorities, may pose a "threat to the legal order in the state", and that in order to carry out any type of activity, local authorities "need a clear and special (i.e. explicitly addressed to them) statutory authorisation, which is a logical consequence of the constitutional principle of legalism (…)".

Problems of the interpretation of legal norms also include the difficulty of ensuring the consistency and compliance of operations with legal requirements, which can lead to negative social and environmental consequences. One of the difficult practical problems associated with the operation of a company operating on the boundary between public and private law is the attempt to reconcile social and economic objectives. This issue remains unresolved.

Importantly, however, the determination of the main direction of the companies' development depends on many factors, including the applicable legislation, the current socioeconomic situation, the financial condition, investment needs, the need to implement modern technologies, or the vision of the owner. This makes it necessary to take decisions with the active participation of the owner and the controlling body, aiming to implement the company's future activities and taking into account the proportion between costs, profits, and the quality of services due to the residents. Nowadays, for the bodies of municipal companies, these issues represent decision-making problems. Hence the need to preserve the principle of legalism and the necessity to create legal norms that would allow the governing bodies and external control bodies to be guided by the same rationale in defining objectives, strategies of action, and measures.

It also appears that a legal definition of a municipal company in the legal system and the establishment of separate and standardised legal norms for this entity would also make it possible to avoid the over-interpretation of provisions or failure to take decisions due to legal uncertainty. Furthermore, it would provide a basis for more effective corporate governance of companies with their shares.

Also, the proposal to create a new organisational and legal form, adequate for the implementation of tasks of a public utility nature, i.e. an intermediate form between a budgetary establishment

and a commercial company, could be a solution allowing for the separation of a municipal public utility with a separate economic and financial status, adapted to the specific purpose (Dolewka, 2022; Wojciechowski, 2012).

Another solution, which piecemeal solves the analysed problem, is to create a different model for evaluating a municipal company on the basis of dedicated financial and economic indicators, and the inclusion of social aspects and objectives with the development of indicators to assess them. To some extent, this could contribute to reducing legal and management dilemmas.

However, it should be emphasised that municipal property, as a type of public property, should be subject to a different management regulation than the civil law one, the aim of which would be to define the optimal way of using this property. A different issue is the clarification and systematisation of legal provisions on the issue of public aid and the definition of services of general interest. Leaving the legal status of a municipal company under the jurisdiction of many different legal acts leads to difficulties of interpretation as well as company owners or managers acting on the edge of the law, in good faith or as so-called good practice.

The activities of local government units and municipal companies, although differing in their specific objectives and methods of operation, should comply with the principles of a democratic state of law. It is important to distinguish that municipal companies, as commercial law entities, operate within the framework of the law and under the supervision of local government units, but are not identical to them. According to the commentary by M. Szydło (Municipal Economy Act. Commentary, 2008), the actions of local government entities should not only remain 'within the framework of the law', but also comply with the fundamental principles of a democratic state of law, which implies transparency, accountability, and the legality of actions.

Conclusions

Taking the above into account, we point out that a municipal company is a specific organisational and legal form, which is a combination of the characteristics of a budgetary establishment and a commercial law company, created in order to effectively perform public utility tasks. It is distinguished by an individualised economic and financial status, adapted to the specifics of the provision of public services. This entity combines the characteristics of public management with the flexibility of action inherent in the private sector, and its activities are based on financial and economic principles that take into account social objectives while striving for efficiency and profitability. In addition, it uses municipal property in a manner consistent with the public interest, in accordance with legal regulations on the management of public property, public assistance, and services of general interest.

The proposed definition seems to provide clear criteria for identifying such entities, highlighting their hybrid nature, combining features of public and private management as well as their role in the implementation of public utility tasks. In addition, a reference to the need to take into account social and economic aspects and the use of dedicated indicators to assess the performance of a municipal company is included. This proposal harmonises with the main message of this article, pointing to the need to clearly define the role and functions of municipal companies, both in legal terms and in the context of the implementation of their socioeconomic mission.

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Jarosław Świda

The Impact of Urban Transport Infrastructure and Its Development on the Users' Sense of Safety: The Case of Kraków

Abstract

Objective: This paper assesses the impact of the new infrastructure in the city of Kraków on the sense of safety of the users of the local transport infrastructure in terms of its growth and influence on the residents' safety.

Research Design & Methods: The research was conducted using questionnaire interviews in a group of 203 respondents in May 2022.

Findings: In the respondents' opinion, Kraków's transport infrastructure positively impacts their sense of safety, and the solutions introduced to increase road safety have served their purpose. The city's transport infrastructure for cyclists is regarded as its weakness, while the best safety-related solutions can be observed in the infrastructure for pedestrians.

Implications/Recommendations: The expansion of the transport infrastructure in urban areas represents a major factor underpinning the development of spatial structure in cities. A well-functioning urban transport system is a condition *sine qua non* for the provision of an effective and efficient transportation service for the city's residents, thus improving broadly understood quality of life. Given a large number of traffic users, the city authorities are under the obligation to ensure that the transport infrastructure is safe for them. The new initiatives and proper infrastructure management help improve the comfort of travel and the quality of life for residents and visitors alike.

Contribution/Value Added: This study contributes to academia and practice by offering data and recommendations to improve the safety of users of city infrastructure.

Article classification: research article

Keywords: transport; urban transport; urban transport infrastructure; road traffic safety

JEL classification: R41

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Introduction

Transport is an integral aspect of human presence in the environment. It stems from the human need to travel from one place to another and move objects between different locations. To satisfy this need, diverse sectors of the economy have been developed, and the infrastructure for transport is regularly built and continuously expanded.

Transport infrastructure is also an integral element of the economy as it enables the provision of transportation services. The lack of cohesion between transport activity and other sectors of the national economy may adversely affect the opportunities of a given nation for growth and lower the living standards of the population.

In recent years, significant changes can be observed in Poland's transport infrastructure. The access to countryside municipalities and their integration with the main cities have improved, thus driving urban population growth. The transport infrastructure in cities is unique in that it entails interactions within diverse groups of users. Since safety is one of the factors that determine the quality of life in cities, the impact of infrastructure on the perceived sense of safety is an issue that calls for examination. The changes that can be observed in Kraków in relation to projects expanding the transport network reveal some infrastructural solutions that can considerably improve user safety.

The aim of the paper is to assess the impact of the transport infrastructure being developed in the city of Kraków on the sense of safety of its users.

Literature review

The term "transport infrastructure" refers to all roads and fixed facilities for three types of transport: land, water, and air, which are needed to enable traffic streams while ensuring safety (Tarka, 2012). The literature offers many definitions of "infrastructure" depending on the degree of the incorporated details. Neider (2019) describes transport infrastructure as "all structures and fixed facilities having a permanent location, which allow for the movement of means of transport and handling equipment, goods and passengers". In contrast, Kristiansen states that "transport infrastructure refers to the means and conditions that may be required to enable the physical movement of individuals and goods, and therefore ensure general conditions for production and services" (quoted after Domańska, 2006). Biehl, in turn, understands transport infrastructure as "a direct instrument of government policy, the long-term strategy of which always requires public resources to be increased, which essentially means more investment in infrastructure, and renders the planning, implementation and financing of such investment projects the main instrument of regional policy". For this reason, developing transport infrastructure in any country is not solely governed by the market alone, but also represents a vital part of national development policies (quoted after Domańska, 2006).

Transport infrastructure performs a number of different roles, such as (Kaczyńska & Korycińska, 2014):

- meeting specific socioeconomic needs by providing spatial linkages;
- fulfilling transport policy tasks by determining the manner in which such linkages can be established;
- determining the built heritage − infrastructure facilities with a long lifecycle can have a lasting impact on spatial development and often become monuments of architecture and symbols of the location where they were built.

Transport infrastructure is regarded as part of national assets, and its accessibility defines the growth of every economy. It is the foundation of socioeconomic activity and its circulatory system that provides access to resources, markets, and goods (Górniak, 2020).

The extension of the transport infrastructure in urban areas is an important factor in the growth of spatial structures in contemporary cities. The transport infrastructure of an urban area incorporates a large number of facilities that form the city's transport network, and an appropriate level of its development is essential for the proper functioning of the public transit system in the city, which is a significant aspect of the broadly understood quality of life (Krajewska & Łukasik, 2017; Vennemo, 2023).

Transport infrastructure is made up of components required for mass (public) and individual transportation. Public transportation infrastructure includes means of transport by road, rail, air, sea, rivers, and lakes, as well as radio navigation systems for air and sea transport. Components of individual transport infrastructure include streets, pavements, and cycleways.

In city transport, road and rail transport vehicles prevail (buses, trolleybuses, passenger cars, trams, and suburban and underground trains). It is quite natural, therefore, that the transport infrastructure in a city needs to accommodate different forms of transport. It is made up of such components as (Wojewódzka-Król & Załoga, 2016):

- roads and streets with fixed facilities that help organise vehicle and pedestrian traffic;
- tram, railway, and underground railway tracks;
- stops, stations, and interchanges;
- bus, tram, and trolleybus depots;
- power supply networks for trams, railways, underground trains, and trolleybuses;
- power substations;
- parking lots.

The recent years have seen considerable strain being placed on transport infrastructure in cities (Głądała, 2020; Gonzalez-Aliste et al., 2023). Excessive pressure on transport infrastructure, known as congestion, is caused by such factors as the ever increasing urban population and too many cars in urban areas. This results in significant reductions of traffic speed, longer congestion periods, and congestion spillover to the access roads. The problem of congestion is a universal problem in cities, most acutely felt in large urban agglomerations and metropolitan areas (Krysiuk, 2016). What is more, there is a close correlation observable in Poland between the motorisation rate and the city size: the bigger the city, the greater the number of vehicles (Pietrzyk-Wiszowaty, 2018). This is also transposed into the dwindling numbers of passengers in public transit systems.

The significant inefficiency and insufficient capacity of urban road systems leads to many problems and jeopardises the safety of road users, particularly their vulnerable groups, i.e. pedestrians and cyclists (Zbyszyński et al., 2015; Svatý et al., 2019).

The concept of "safety" is an entrenched human need and a vital value required for both individuals and social groups to grow. It is most often understood as a state of certainty, calmness, being free from external threats (Lewandowski, 2010). Safety issues and potential hazards are caused, deliberately or not, by human actions that result in the weakening or disrupting of the transport system, including public transport, and(or) death(s) of passengers or service personnel (Pietrzyk-Wiszowaty, 2018).

The meaning of safety in road traffic is expounded by Siedlecka and Mądziel (2016) in their study. The authors define it as "a condition of the public road enabling smooth and efficient operation of traffic without endangering the lives and property of road users".

The International Association of Public Transport (2011) names three pillars of safety in collective transport (Janczarska-Bergel, 2022):

- human factors – qualified personnel;
- procedures – a well-designed safety programme based on accident analysis and risk assessment;
- technologies – monitoring, introduction of innovative visual (warning) elements, and better lighting (e.g. crossings).

Since traffic safety is closely related to vehicles, road users, and their immediate surroundings, it can be said that – in addition to the road infrastructure – the level of safety depends on the vehicle designs and the skills of drivers, cyclists, and pedestrians (Wojtas & Szkoda, 2018, Costin et al., 2018, Szruba, 2019).

The development of transport infrastructure involves many dilemmas relating to investment policies in urban areas, while the decisions made ought to factor in upgrading the quality of life by increasing the safety of the city residents and traffic users (Kubejko-Polańska & Marcinko, 2015).

Research methodology

The research on the impact of Kraków's transport infrastructure on the sense of safety of its users was conducted in 2022, and was preceded by a pilot study. The surveyed group included 203 adult respondents living in the city of Kraków and its environs, who were users of the city's transport infrastructure. Their characteristics are presented in Table 1.

Table 1. The characteristics of the respondents

Age	Women	Men	%
18–25	68	45	56
26–35	26	21	23
36–45	10	12	11
46–55	9	5	7
56–65	0	2	1
65+	1	4	2
Share	56%	44%	100

Source: Own elaboration.

The research was conducted using the CAWI method. The survey questionnaire included questions on the perception of the city's s transport infrastructure by its users and questions relating to the respondents' characteristics. The sample's selection was non-random.

Based on the information from the respondents, the study aimed to:

- identify the degree to which the transport infrastructure affects safety in comparison to other road traffic factors;
- find out how the users assess the condition of Kraków's transport infrastructure and its development prospects;
- identify the elements of transport infrastructure which are perceived by the individual groups of respondents to be the most dangerous;

- find out how the respondents view some examples of infrastructural solutions applied in Kraków to improve road safety.

The findings were analysed and presented in the form of tables and figures.

Results and discussion

The results of the survey are presented in the tables and figures below. First, the respondents were asked to indicate the means of transport they chose most often while travelling in Kraków (Fig. 1).

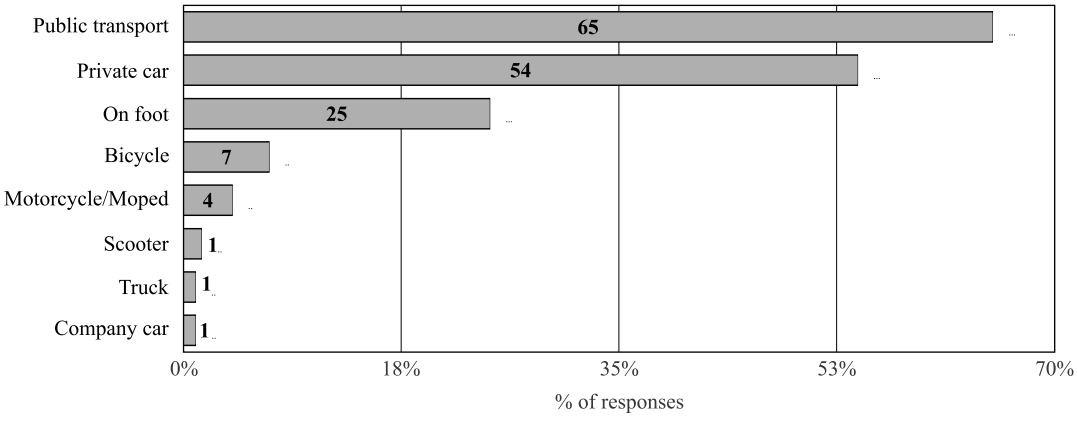

Figure 1. Means of transport chosen for travelling in Kraków

Source: Own elaboration.

The majority of the respondents use public transport and private cars for mobility in Kraków. Walking is also popular and is frequently combined with other forms of transport.

The respondents were also asked about the frequency of their use of the city's transport infrastructure and the average overall daily travelling times (Fig. 2).

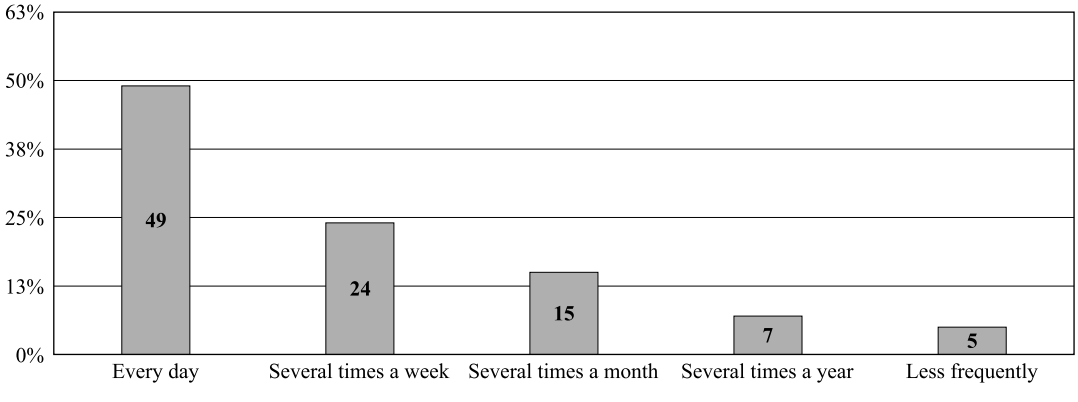

Figure 2. The frequency of using Kraków's transport infrastructure

Source: Own elaboration.

The survey indicates that half of the respondents use transport infrastructure daily, and 24% up to several times a week, while 15% not more than several times a month.

The question on the average daily time spent travelling in Kraków was open-ended, and the elicited responses varied from 20 minutes to 10 hours. The most frequent answer was one hour (33%), followed by two hours (28%) and one and a half hour (13%). Only 7% of the respondents need less than an hour to reach their destination and travel back.

The elicited answers found that the respondents have frequent interactions with Kraków's transport, and use it in various situations and at different times of day.

The next part of the survey included questions on the city's transport infrastructure. First, the respondents were asked if they felt safe as road users in Kraków (Fig. 3).

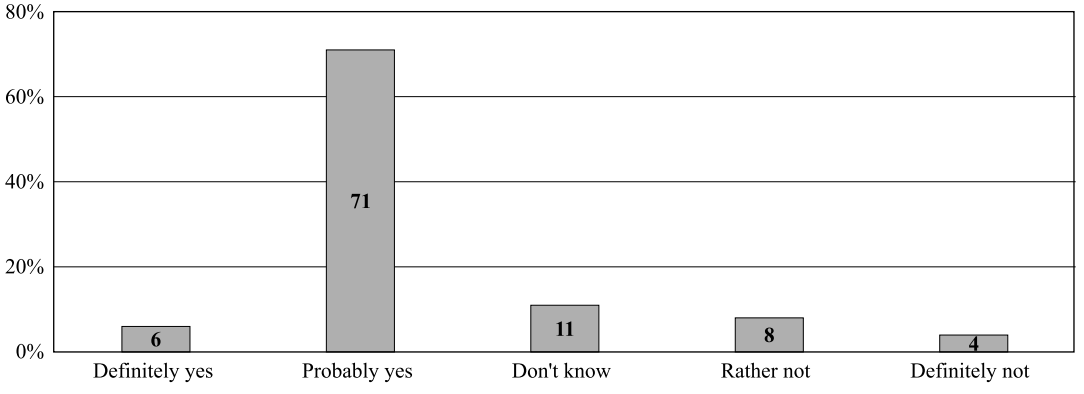

Figure 3. The sense of road safety in Kraków

Source: Own elaboration.

The majority of the respondents felt safe (77% in all), 12% did not feel safe, but as many as 11% were not able to define their opinion in this regard.

The respondents were also asked to assess the current condition of Kraków's infrastructure on a scale from 1 to 5, where 1 was Very Poor, and 5 – Very Good (Fig. 4).

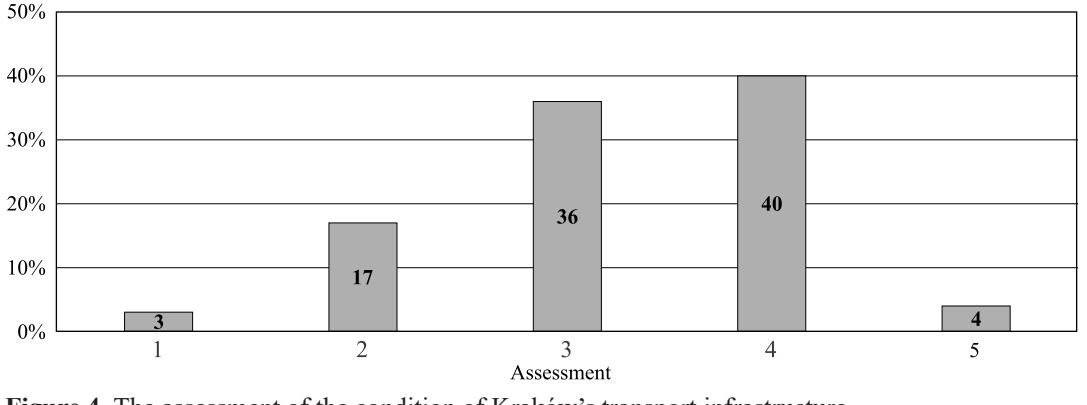

Figure 4. The assessment of the condition of Kraków's transport infrastructure

Source: Own elaboration.

The state of the transport infrastructure was assessed as good by 40% of the respondents, whereas only 4% regarded it as very good. As many as 20% of the respondents did not think very highly of the city's infrastructure, possibly because of daily congestion caused by its limited capacity, as well as omnipresent repair and maintenance works which hamper unimpeded travel in the city's main thoroughfares.

The question on the state of the city's infrastructure was followed by one concerning its impact on the respondents' perceived safety (Fig. 5).

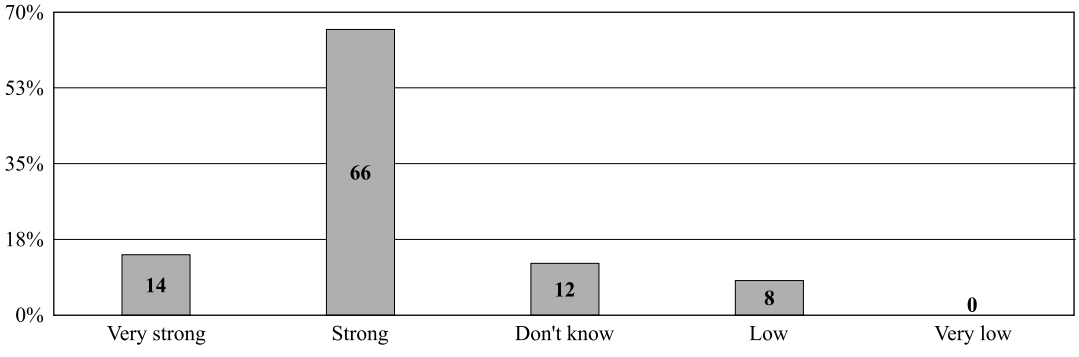

Figure 5. The impact of Kraków's transport infrastructure on the sense of safety

Source: Own elaboration.

The road infrastructure considerably affects the sense of safety for 66% of the interviewees, as compared to 8% who believe that this impact is insignificant, whereas 12% of the respondents did not have an opinion on this matter.

In the next part of the survey, the respondents were asked about those locations in Kraków in which they felt the least safe as road users, pedestrians, cyclists, and drivers.

The respondents were to select not more than three locations which are perceived as the least safe for pedestrians (Fig. 6). Most respondents listed roadsides, shared paths for pedestrians and cyclists, and pedestrian crossings. According to police statistics, the latter are indeed frequent sites of traffic incidents. Kraków is no exception: Poland's second-largest city still has many streets with roadsides only, which offer no protection from the approaching vehicles.

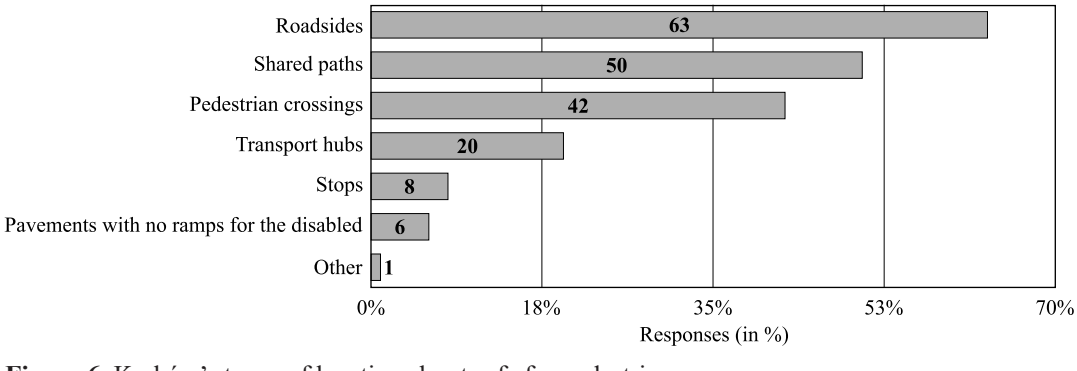

Figure 6. Kraków's types of locations least safe for pedestrians

Source: Own elaboration.

Figure 7 shows the distribution of dangerous sites for cyclists, as listed by the respondents.

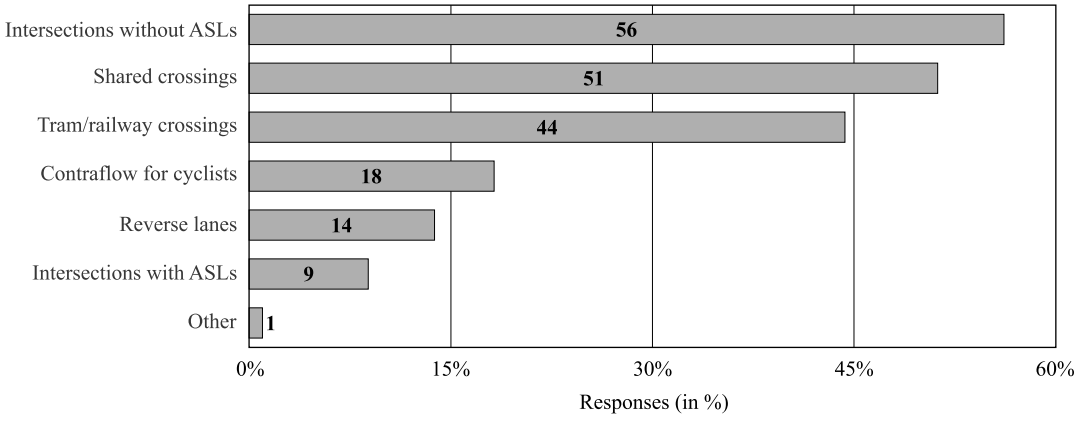

Figure 7. Types of locations least safe for cyclists in Kraków

Source: Own elaboration.

Most respondents listed intersections without advanced stop lines (ASLs), i.e. facilities that alert drivers to cyclists' presence and also streamline their safe passage along the cyclist-dedicated lanes and crossings. For this reason, shared crossings for pedestrians and cyclists were named as the second least safe arrangement. The respondents also cited contraflows and reverse lanes.

Figure 8 lists the respondents' answers concerning sites which are regarded as dangerous for drivers travelling in Kraków.

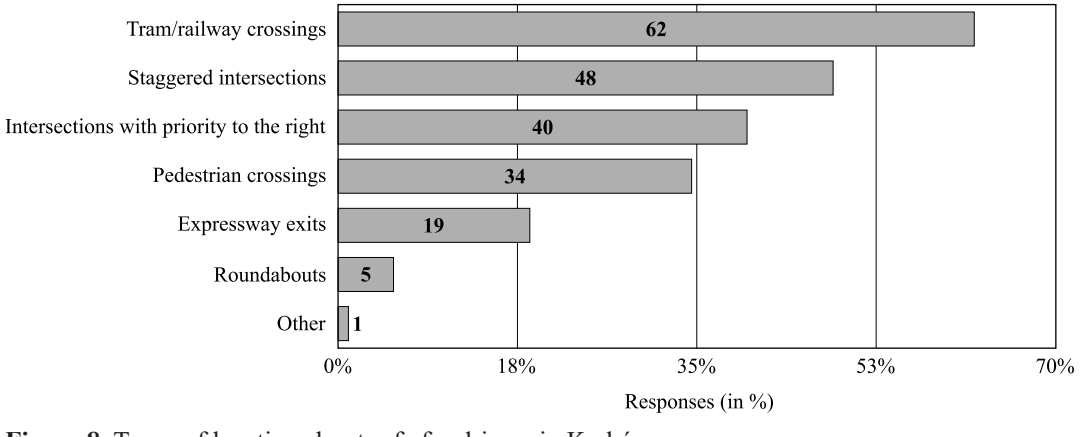

Figure 8. Types of locations least safe for drivers in Kraków

Source: Own elaboration.

According to the respondents, the least safe places for drivers are tram and railway crossings, where accidents do not happen very often, but their consequences can frequently be catastrophic. The second listed were intersections where general traffic rules should be obeyed due to the absence of traffic lights. The respondents also indicated pedestrian crossings where drivers have to watch out for other road users who have right of way at that particular location.

Once the interviewees named the most critical locations of Kraków's road infrastructure, they were asked about those elements of the road infrastructure which in their opinion improve the safety of users: pedestrians, cyclists, and drivers. The respondents could select not more than three answers. As regards pedestrians' safety, the respondents considered the illumination of the pedestrian crossings to be the factor that could contribute the most to pedestrian safety (Tab. 2). The second most popular answer suggested constructing pavements in place of the existing roadsides, mainly with a view to ensuring the safety of youngest road users, the elderly, and persons with disabilities. This was followed by solutions aimed at protecting pedestrians through calming the traffic, such as speed bumps or pedestrian-activated measures such as light signals or other signalling devices.

Table 2. Elements of road infrastructure improving pedestrians' safety in Kraków

Elements of road infrastructure	Responses (in %)
Illumination of pedestrian crossings	54
Pavements in lieu of roadsides	41
Speed bumps	35
Marked pedestrian crossings, variable message signs	26
Interactive, pedestrian activated crossings	25
Splitting pavements into pedestrian and cycle lanes	21
Speed cameras	21
Lane separators close to pedestrian crossings	14
Crossings with pedestrian refuges or road narrowing	13
Speed limit signs	9
High curbs	7

Source: Own elaboration.

A similar question was asked in relation to measures that improve cyclists' safety (Tab. 3).

Table 3. Elements of road infrastructure improving cyclists' safety in Kraków

Elements of road infrastructure	Responses (in %)
Uninterrupted cycleways	75
Surface condition of cycleways	40
Appropriate signage	34
Illuminated crossings at intersections	30
Advanced stop lanes (ASLs)	29
Bicycle crossings across carriageways	28

Source: Own elaboration.

Most respondents named the component of the cycling traffic that is missing in Kraków, that is the continuity of cycleways. The absence of uninterrupted cycleways can lead to dangerous situations involving cyclists and drivers or pedestrians since their respective routes frequently

intersect. The respondents take the view that appropriate signage and lighting illuminating intersections are more desirable solutions to be applied. Similar conclusions were formulated by Reynolds et al. (2009), who pointed out that cycle lanes are the key factor in improving cyclist safety, and named street lighting and paved roads as additional factors that can restrict hazards of accidents and cyclist injuries.

In the next question, the respondents were asked to list up to three infrastructure solutions improving driver safety (Tab. 4).

Table 4. Elements of road infrastructure improving driver safety in Kraków

Elements of road infrastructure	Responses (in %)
Condition of road surface	28
Street lighting	25
Roundabouts	18
Interactive pedestrian crossings – signalling pedestrians' presence	15
Appropriate signage, variable message signs (VMS)	13
Speed cameras	7
Speed limit signs	7
Narrowed lanes and changes to road geometry to calm traffic	7
Road bumps/humps	6

Source: Own elaboration.

The respondents listed the road surface condition as the key element that determines safety. Drivers also regard street lighting as a significant aspect as it enables better and faster responses to stimuli from the environment after sunset. Roundabouts were the subsequent solution listed by the respondents, since they have fewer collision points than traditional intersections, while devices designed to reduce vehicle speeds were less frequently listed by the respondents.

The respondents were also asked to evaluate the state of road infrastructure in view of many road repairs being conducted in the period prior to the study and financed from the EU or local funds. Given the fact that many investment projects were not halted during the COVID-19 pandemic, the respondents were asked whether the recent changes were visible and whether they made any difference; their opinions are presented in Figure 9.

Most of the respondents observed certain or even considerable improvement during the past two years. Therefore, they were subsequently asked whether the development and improvement of the infrastructure increases their perceived safety (Fig. 10).

The number of the respondents with an increased sense of safety was nearly the same as that of those interviewees who felt no improvement. This is a disheartening result, as Kraków's road infrastructure was regarded as an important element of safety by 80% of the interviewees.

In the subsequent part of the survey, the respondents were asked to evaluate specific infrastructure solutions and their impact on their sense of safety. The first question was about countdown timers at Kraków's intersections (Fig. 11).

Even though the impact of countdown timers on improving road safety has not been corroborated by research, as many as 74% of the interviewees admitted that these devices do improve their

sense of safety. This is an interesting finding in the light of the psychological effect such devices can have on drivers.

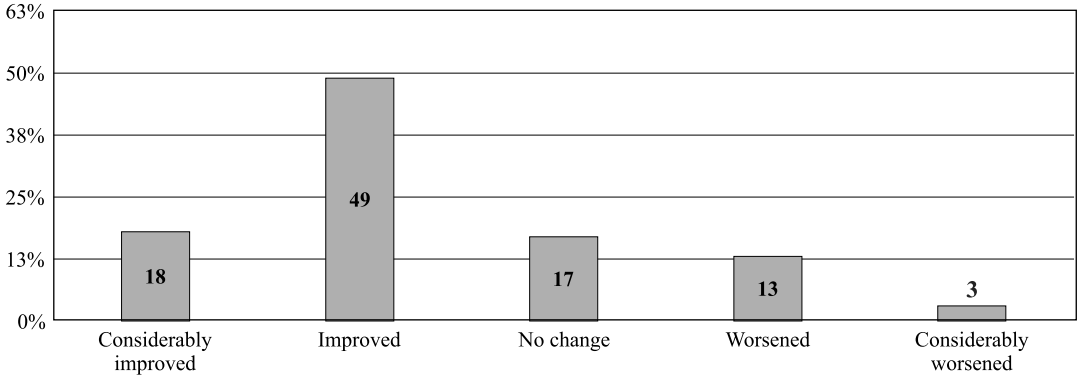

Figure 9. The assessment of the development of Kraków's road infrastructure in 2020–2022

Source: Own elaboration.

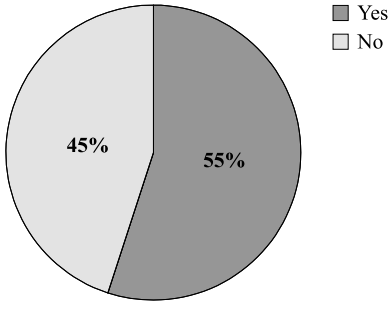

Figure 10. The evaluation of the impact of the development of Kraków's road infrastructure on increased sense of safety

Source: Own elaboration.

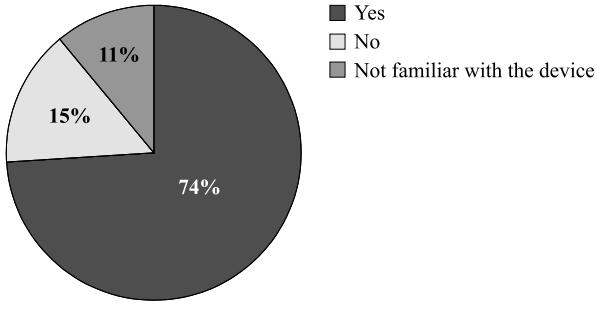

Figure 11. The evaluation of countdown timers on safety improvement

Source: Own elaboration.

The next question tackled the issue of cyclist safety in Kraków's streets. Figure 12 shows the distribution of the answers to the question whether the application of ASLs at intersections helps improve cyclists' sense of safety.

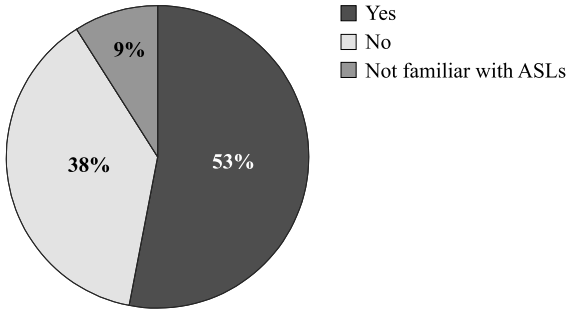

Figure 12. The evaluation of ASLs on safety improvement

Source: Own elaboration.

Slightly more than half of the interviewees were of the opinion that ASLs improve safety, whereas 38% respondents did not share such a view. One reason for this could be the lack of knowledge among both cyclists and motorists passing by on how such solutions ought to be used.

Since pedestrians are the most vulnerable group of road users, and most road incidents take place at pedestrian crossings, the respondents were presented with four types of such crossings and asked to assess them on a scale from 1 (Least Safe) to 5 (Most Safe) (Fig. 13).

In terms of the weighted average, refuge island crossings were most favourably assessed (with an average of 3.9). Such crossings enable pedestrians to cross the street in two stages and also offer safe harbour in the case of driver errors. Narrowed crossings were the next most popular solution listed by the respondents with regard to their sense of safety (3.8). Reducing the width of the carriageway to one lane makes the crossing shorter and therefore safer. Drivers slow down at such spots not only because of pedestrians; they need to make sure that no other vehicle is coming from the opposite direction. Humped zebra crossings were the solution ranked as third by the respondents (3.7); they force the drivers to slow down and act as an obstacle to speeding motorists. Crossings with lane dividers (separators) installed before the crossing were the least popular with the respondents (3.3). The significant number of 2 and 3 ratings accorded by the respondents suggests that they do not feel such a solution guarantees a safe passage across the street. Similarly, such crossings are not found reliable by drivers owing to the potential risk to the vehicle, mentioned above.

The last two questions were open-ended and asked about the kinds of problems experienced by road users in Kraków and about their suggestions related to improving safety. The first question asked about the facilities in the city's road infrastructure aimed at improving safety. The respondents were requested to list those solutions which are not effective or give road users a false sense of safety. The menu options most frequently cited were speed cameras and speed limit signs, followed by ASLs and pedestrian crossings with lane dividers. Slightly fewer respondents cited other types of pedestrian crossings: humped, with refuge islands, and with narrowed lanes, probably due to the illusory sense of safety that they offer to pedestrians. Some respondents also listed unlit pedestrian crossings and bicycle carriageway crossings.

Finally, the respondents were asked to propose solutions that would, in their opinion, improve the safety of Kraków's roads. A substantial majority of the answers opted for the illumination of pedestrian crossings. Furthermore, many respondents suggested to separate pedestrian traffic

from bicycle and motor traffic. Others opted for new pavements, upgrading of the road surface, and the provision of appropriate and easy to understand signage. Many of the submitted proposals were not directly related to infrastructure but, rather, called for making changes in the regulations and educating road users.

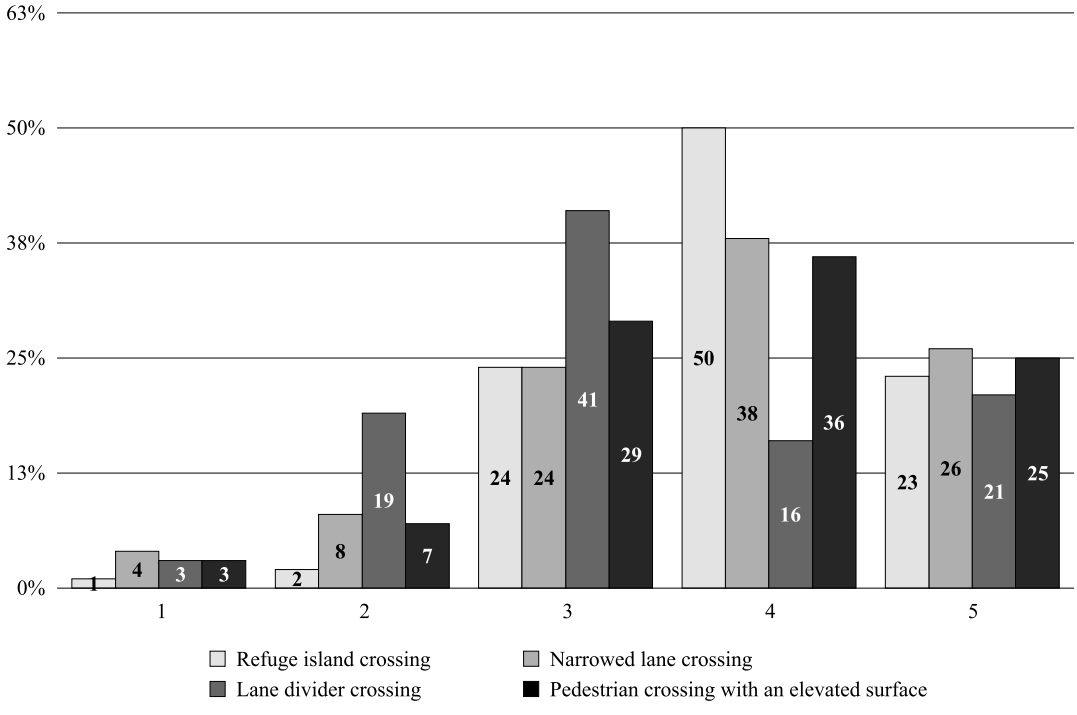

Figure 13. The assessment of four types of pedestrian crossings in terms of safety

Source: Own elaboration.

Conclusions

The study led to the following conclusions:

1. Most of the interviewed users of Kraków's transport infrastructure note that its condition has improved.
2. Pedestrians in Kraków have the lowest sense of safety in those locations which had direct contact with other traffic users – cyclists or motorists. For this reason, roadsides, shared (multi-use) paths, and pedestrian crossings are those components of Kraków's transport infrastructure that require additional measures to improve pedestrian safety.
3. For cyclists, the intersections of various routes, roads, and paths are the least safe places in the city. As is the case with pedestrians, the points of contact with other traffic users can be problematic, such as intersections without shared crossings for pedestrians and cyclists or tramway crossings. The respondents also suggested some solutions to improve cyclist safety and convenience, such as contraflows and reverse lanes.
4. Drivers in Kraków consider intersections with trains or trams or sites where there are no automatically controlled traffic lighting and users need to know basic traffic regulations to be

the city's least safe locations. These include train and tram crossings, staggered intersections, priority-to-the-right intersections, and expressway exits. Such places need to be properly and clearly marked.

5. Solutions that can most significantly improve pedestrian safety are those that increase their visibility at street crossings and those that inform drivers about pedestrians' presence, thus allowing them to slow down and offer safe passage to the pedestrians.
6. One solution that would definitely improve cyclists' safety is the continuity of cycleways.
7. The most considerable factor increasing the drivers' sense of safety is the improved condition of the road surfaces and street lighting.
8. ASLs are a solution that is well received by most respondents. One potential source of problems is the conflict between drivers and cyclists, when the driver needs to quickly leave the intersection, whereas the cyclist wants above all to ride safely alongside the faster and larger vehicles driving by.

The findings from the research suggest that the infrastructure for cyclists is the Achilles' heel of Kraków' transport infrastructure. What first and foremost calls for improvement is the continuity of cycleways, a factor which has been cited as the main condition underpinning the respondents' improved sense of safety. Another weakness of Kraków's transport infrastructure is its low capacity, limited by congestion; this calls for changes in the present road infrastructure and in the user attitudes. Since the city's investment projects often take a long time to complete, the users do not feel safe while travelling in diversion roads, or are forced to seek alternative routes. On the other hand, the pedestrian infrastructure is Kraków's definite asset as far as the respondents' perceived safety is concerned; the users note and appreciate the solutions being introduced.

The study found that the users of Kraków's transport infrastructure are aware that the infrastructure affects their safety.

Due to the growing number of traffic users, the city authorities are under the obligation to ensure safety to the users of its transport infrastructure. By introducing new measures and addressing the infrastructure's needs, the comfort of travel and the quality of life are increased for both residents and visitors.

The study's limitations that could be addressed in future research include the use of a larger sample in studies encompassing a broader variation of characteristics. Furthermore, the respondents' perceptions could be set against those of the policymakers to identify the differences in the assessment of the city's transport infrastructure and assess the planned solutions to improve the safety of its users. The safety of the residents and visitors alike is a crucial factor in ensuring a high quality of life in the city. Therefore, research in this area ought to be continued.

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Journal of Public Governance

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Journal of Public Governance (formerly *Zarządzanie Publiczne / Public Governance*) is a quarterly published since 2007. It is intended for experts and researchers who specialise in public issues, including political decision-makers and students. It offers a forum for debates between academics and practitioners interested not only in the theoretical foundations of public governance but also in the opportunities for its practical application. The quarterly is international in scope, which is reflected in the nature of research issues (they involve matters of interest to academic circles worldwide), the contributing authors (a significant proportion of them comes from different countries), and the composition of its Programme Board as well as the make-up of the team of reviewers (it includes international research and academic centres).

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